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***E**volution* has been defined as "descent with modification." Now *hereditary* modifications must therefore be the basic materials for evolution, and the manner of origin of hereditary variations must therefore be the first major problem of evolution. Lamarck attempted to solve this problem with the theses that the action of the environment on an organism tends to produce adaptive modifications, and that these acquired characters are inherited. He failed because both of these theses are easily disprovable.

Darwin side-stepped this problem. He simply accepted without explanation the observed fact that organisms do vary one from another, irrespective of cause. He did not distinguish between inheritable and non-inheritable variations. His problem was the action of natural selection which caused the formation of species, if a variable progenitor is granted.

The second major problem of evolution is the origin of discontinuity within a varying series, for by this means several segments of a single species become distinct species. This is the problem with which Darwin was primarily concerned. It is important to realize that discontinuity is the basic means of distinguishing between closely similar species. The differences between several subspecies of a single species may be quite as great as those between species of a single genus. Yet there is no sharp line of separation between subspecies. They hybridize freely with their neighbors, and intergrades between adjacent subspecies are common in nature. The hallmark of good species is that, however small the differences between related species may be, they are consistent differences, so that Goldschmidt can speak of "the bridgeless gap" between species.

With these two main problems the subsequent chapters will be largely concerned. But first it may be profitable to survey the actual course of evolution as shown by the paleontological record and by other data.

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Arctic Botanical Research

Until recently our knowledge concerning plants of the Alaskan Arctic has been based chiefly on observations and collections made along or near the sea coast. Opportunities to improve this situation occurred in 1946, when the U. S. Navy initiated a search for petroleum in Arctic Alaska, and in 1947 when the Office of Naval Research sponsored an Arctic Research Laboratory at Point Barrow, at latitude 71° 20′ N. This laboratory was operated first under a contract between ONR and Swarthmore College, and since July 1, 1949, between ONR and The Johns Hopkins University. Basic research that can be done only, or most effectively, within the Arctic has been emphasized in the programs pursued at Point Barrow.

The teams engaged in research at the Arctic Research Laboratory are employed by their own institutions to perform the investigations. The financial and logistic support at Point Barrow is furnished through separate contracts between the respective home institutions and ONR. Some investigators have been supported by grants from the Arctic Institute of North America, but they have drawn logistic support from the ONR through ARL.

Among the teams and individuals engaged at Point Barrow have been a number of botanists whose research has carried them into the interior or has permitted them to study intensively the native plants and the ecological factors operative there. Their activities have resulted in the accumulation of many thousands of specimens of flowering plants, lichens, mosses, algae, and diatoms. Most of their work has stressed the taxonomic phase of botany, for as yet the flora of the region is imperfectly known, and much must be accomplished taxonomically before the plants can be utilized fully by physiologists, ecologists, geneticists, and biochemists.

Among those who have carried on recent field work, the man who has spent the most time on the tundra and the north slopes of the Brooks Range is Lloyd Spetzman. While a graduate student in botany at the University of Minnesota he spent five summers in the area as an employee of the U. S. Geological Survey. During another summer he was supported by the A.I.N.A. Others interested in flowering plants, who have worked out from the ARL, have been Laurence Irving and P. F. Scholander, Swarthmore; Lyman Benson, Pomona College; Henry J. Thompson, John H. Thomas, Kenton L. Chambers, and Ira L. Wiggins, Stanford University. Field work restricted to special groups has been done by Leonard Freese, Houston University, with diatoms; George Llano, then with the U. S. National Herbarium, with lichens; G. W. Prescott and two assistants, Michigan State College, with algae; W. C. and Dorothy O. Steere, Stanford University, with mosses; C. A. Arnold and two assistants, University of Michigan, with paleobotany. Several members of USGS field parties have made valuable collections and forwarded them to the National Museum or to specialists for study.

Paul D. Voth, University of Chicago, studied the ecology of a liverwort (*Marchantia polymorpha*) near Point Barrow in 1951. Daniel Q. Thompson, University of Missouri, investigated the interrelations between plant cover and lemmings. Dr. Scholander studied the ecology and physiology of certain plants in the Alaskan Arctic, and F. G. Gustafson, University of Michigan, collected and lyophylized material for determining the vitamin content of arctic plants. I. L. Wiggins and his assistants attacked some of the cytotaxonomic and morphological problems associated with arctic plants.

Only a small part of the data obtained has been analyzed and the results published. Several years' work will be required to exploit this potential, even if field work were suspended now. Cessation is not contemplated. On the contrary, continued studies, by five teams of investigators, dealing with flowering plants, bryophytes, algae, and with the relationships of microclimates to arctic plants are planned for the summer of 1952.

Ira L. Wiggins
Stanford University and *Arctic Research Laboratory at Point Barrow*
Fairbanks, Alaska

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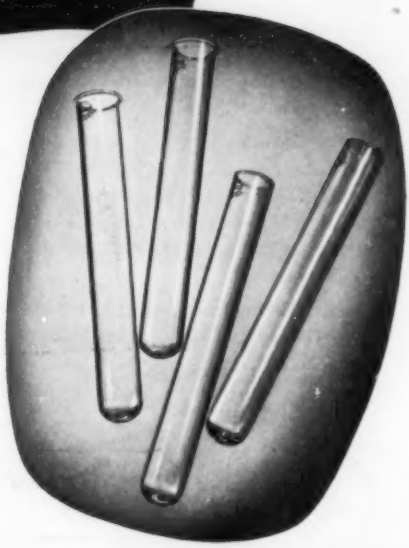

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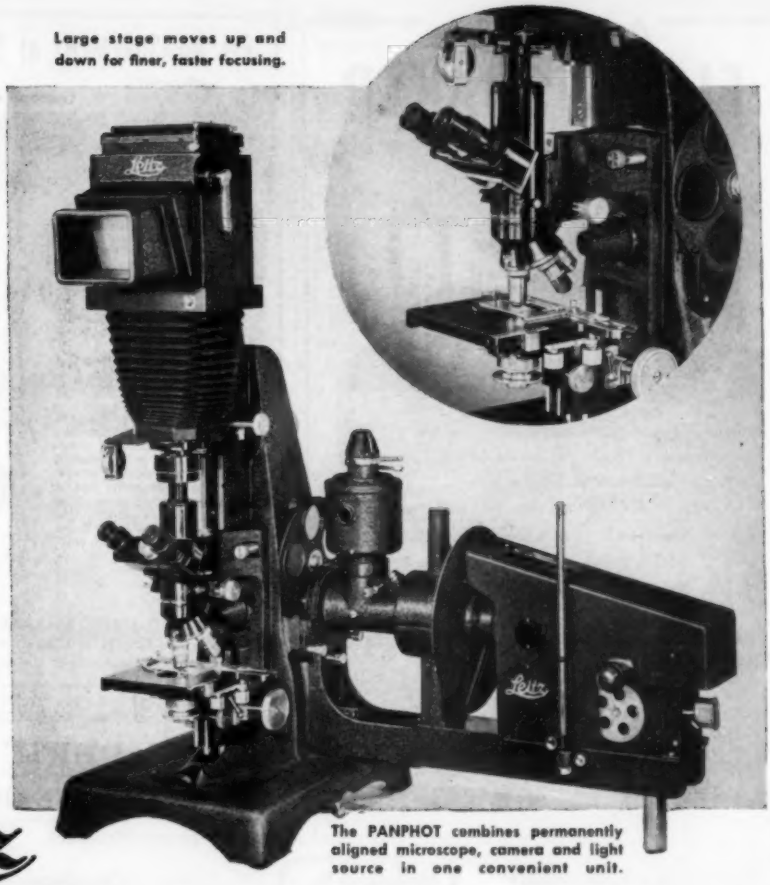

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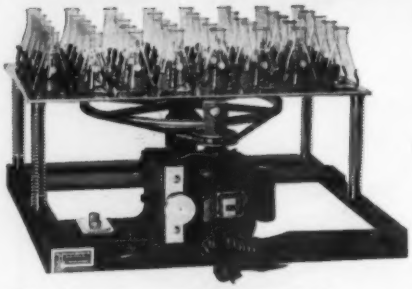

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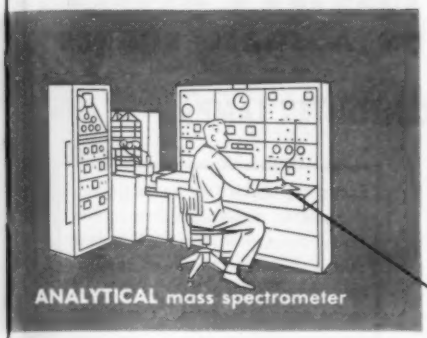

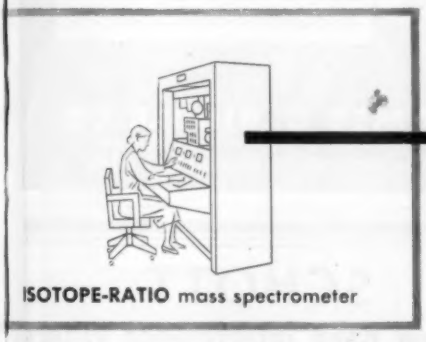

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The Problem of Antiscientific Trends Today[1]

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ALTHOUGH SCIENCE AND SCIENTISTS have never enjoyed the wholehearted approval of all people everywhere, there is abundant evidence to indicate a very serious decline in their popularity during the past few years. The climate of public opinion has changed from one in which scientists could bask in the sunshine of widespread admiration, respect, and even awe, to one in which the storm clouds of suspicion, recrimination, and fear endanger the intellectual progress and continuing welfare of mankind. Recent trends in America are too well known to require documentation.

There are three responses that the scientist may make: He may emulate the fabled ostrich, bury his head in the sand, and refuse to admit that there are any clouds in the sky. He may retreat to his ivory tower (or his white-tiled laboratory) and wait until the storm blows over. Or he may analyze the contemporary situation, seek to discover the causes of adverse developments, and do his best to reverse the trend before it has done irreparable harm. Obviously, I prefer to take this third course.

In doing so, it is well to distinguish between science, a method of gaining knowledge and the means whereby human welfare may be improved, on the one hand, and scientists, the individuals who use that method and apply those means, on the other hand. The distinction is sadly blurred in the popular mind, as are so many other things, but it should be kept clear if we are to grapple successfully with our problem.

Critics of the philosophy and strategy of science have been with us for centuries. They were especially vocal during the latter half of the nineteenth century, when evolution was vigorously attacked because of its alleged antagonism to widely held religious beliefs. Their voices have reached a new crescendo in late years, and new charges are now being hurled along with variations of the earlier theme. Many still believe that the philosophy of science is mechanistic and materialistic, that it reduces man to something closely akin to a complicated machine, and denies, or at least minimizes, the spiritual aspects of human life. A considerable portion of the current antagonism to science in America stems from the suspicion that science may be largely responsible for the abandonment of moral principles and the destruction of ethical standards, which undoubtedly have occurred in recent years. The problems of human relationships have certainly become more acute as the fruits of scientific research have been increasingly applied to the practical affairs of everyday life.

One reaction to this situation on the part of many scientists has been to remind the critic that the social sciences are, in fact, much less advanced than the physical and biological sciences. Let the strategy of science be applied more intensively and extensively to the problems of the individual as a member of society and of the community as an organization of individuals, and soon all will be well with the world. What we need, to eradicate the existing evils, is not less, but more science, is the frequent response to this particular type of antiscientific criticism.

Although I am heartily in favor of "more science" and welcome every new insight gained in the social sciences, I do not believe that such a response will have any significant effect upon the current antiscientific trends. The thought that prompts it is fundamentally unsound. In the market place of public opinion, where ethical and moral values are appealing for recognition, appraisal, and loyalty, the sciences are neutral. The release of atomic energy from nuclear fission by chain reaction, for example, has no moral significance, in and of itself. It is what men do with this new and spectacularly dynamic form of energy that is either good or bad. The primary objective of science is to increase the efficiency of men, of their minds and bodies, their tools and implements, their techniques and institutions. But it is all too obvious that there is little if any correlation between scientific efficiency and righteous morality.

This has long been recognized by workers in the physical sciences and accepted for many aspects of the biological sciences. I believe it also applies to the social sciences. It is doubtless true that the development of the social sciences has thus far been prompted in the main by the desire to promote human welfare. Most social scientists are inspired by fine motives. Nevertheless, it is all too evident that the new knowledge of human behavior may be used to serve bad as well as good ends. Scientific methods of propaganda have been applied with great success by autocratic dictators to pervert great numbers of citizens in certain countries. Modern advertising campaigns are using this knowledge for ends that may be detrimental to social progress, as well as for highly commendable purposes. The use of the new social tech-

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niques by governments and pressure groups may prove to be more fundamental to the evolution of society in these times of rapid change than economic structures or social stratification. Even here, the knowledge and tools of science reveal themselves only as means to an end. And the end may be either beneficent or malevolent, depending upon the purpose toward which the technicians direct their efforts.

If this analysis of the limitations, as well as the powers, of science be anywhere near the mark, it suggests the strategy that should be used by those who seek to reverse the trend of antiscientific thinking in the popular mind, insofar as it derives from the consideration of morals and ethics. Let us not play the game according to the opposition's rules. Instead, let us have something to say about the rules ourselves. Do not apologize for the failure of science to do things that science alone cannot be expected to do. Displaying something of the humility that has always characterized every really great scientist through all the years, we should push the battle line forward into the very camp of the enemy. The great, imperative problems of our day cannot be solved unless something is added to the intelligence of science. The world's troubles are really caused by the fact that the dynamic of good will is not adequate to direct beneficially the vast resources of intelligence that are at hand.

If civilization is to be saved from catastrophe, the ethical consciousness of each of us must be greatly strengthened, renewed, and improved. The wellsprings of good will lie deep within the spirit of man, not in the outer, public world. Science discloses the imperative need; something that transcends science must assist men to respond to this challenge of our time. The scientist is just as responsible for failure or success along these lines as the nonscientist—neither more nor less responsible than every other intelligent citizen.

Let me be specific here. Nuclear physicists have frequently been castigated for their part in the production of the atomic bomb, the most efficient means of mass destruction we have thus far known. Other scientists are charged with what amounts to immorality for their indispensable assistance in the development of new ingredients of chemical and bacteriological warfare. Many scientists in various professional fields are criticized for not leaping precipitously to the barricades and demanding that all such new weapons be outlawed immediately by international agreement. Such antiscientific propaganda has had the beneficial effect of focusing the attention of scientists upon the social consequences of their work, but that by-product of this disparagement is merely a validation of the customary interpretation of the adage "It's an ill wind that blows nobody good."

Our strategy in meeting such charges of immoral purposes and unethical conduct follows directly from what was stated above. New knowledge gained through scientific research, no matter under what auspices the research is carried forward, provides the means with which to achieve objectives. It is no greater sin to kill people with the searing heat of an atomic explosion, or the paralyzing trauma of poison gas, than with the old-fashioned explosives of a saturation bombing mission, the bullets of machine guns or, for that matter, a crossbow or a stone ax. It is war itself that is immoral, not the weapons used by warriors. The critic of the scientific improvement of the means for waging war should therefore promptly be invited to join with us in the more important and most highly ethical project of discovering and eradicating the causes of war, in order that the world of humanity, with its present tensions and strife, may be transformed into a world of intelligent cooperation, in which adequate means for the restraint of aggressors will be established and there will be no valid excuse for the resort to war.

Few of the critics of modern science are aware of the extent to which research and development in each of the sciences, from psychology, sociology, and political science, through geology and geography with their emphasis upon conservation of resources, to biology, physics, chemistry, and even astronomy, are providing the data and the techniques necessary for progress in that direction. The only valid criticism that could be leveled against scientists on this score would be based upon their reticence and their reluctance to enter the public forum to exert an influence, commensurate with their insight, upon the currents of public opinion.

Here, however, one phase of the current antiscientific trend finds many scientists in a dilemma. Is it realistic to make unlimited promises about the benefits that mankind may derive from the applications of science? In the long run, will not all attempts to raise the standard of living in densely populated, underdeveloped countries prove futile? Demographers and conservationists do well to remind us that, if the increase in population resulting from improvements in economic conditions and the lowering of death rates is unrestrained, it may put an impossible burden upon available resources. But great care must be taken lest science be further discredited in the public mind. It is almost a case of "damned if we do and damned if we don't."

It is presumably the aim of scientists to enable men and societies to conduct their affairs in increasingly efficient and beneficent ways. Efficiency involves value judgments that are relatively easy to make; everybody agrees that penicillin is more efficient in the treatment of certain diseases than any drug at hand before antibiotics were available. Beneficence is in another category; the value judgments it involves are relatively difficult to make. Men of apparently equal intelligence differ widely in their appraisal of the multifarious procedures proposed for attaining contentment, happiness, and peace. No wonder there is much difference of opinion among the scientists of the United States concerning what is best for the people of India, China, Java, and Puerto Rico.

This is neither the time nor the place to marshal the data concerning fertility, mortality, and resources, both utilized and potential, in various parts of the

earth. Permit me merely to share with you some conclusions that seem to me to be justified.

At the present time, about 40 per cent of the earth's inhabitants appear to be living under conditions to which the Malthusian principle of external restraints does not apply. The rate of population increase is not for them determined by limitations upon the means of subsistence. The other 60 per cent of the world's population is apparently under the Malthusian restrictions. These are the closely crowded masses of large parts of Asia and certain regions of Africa and Europe, as well as a few localities in the Western Hemisphere. For one reason or another—be it ignorance or exploitation—these people are not taking full advantage of the opportunities that modern science and technology can provide for improving their means of subsistence. Give them the assistance and the freedom that they need to make the most of their own opportunities, and they will develop the same pattern of population change that has characterized every technologically advanced nation in recent years.

It is quite erroneous to use the statistics of recent population growth, as certain of the neo-Malthusians have been guilty of doing. The increase of the world population and the expansion of numbers in many nations during the first half of the twentieth century are unique phenomena in the history of mankind. Medical research, since the turn of the century, has greatly lengthened the average span of life. A large fraction of the people now living would long since have been dead, were it not for modern sanitation, public health measures, and medical or surgical treatment that was unavailable a century ago. It is, however, the lethal diseases of infancy, youth, and early maturity that have largely been conquered. Diseases of old age are still almost as obdurate as they have always been. Death rates have declined while the average age of the inhabitants of all technologically progressive communities has been advancing. But this trend must inevitably reach its limit. In spite of all that medical science can do, death rates will increase before long among such communities. We here in America, for example, will soon be "taking up the slack" resulting from the recent lengthening of our average life span.

Since 1900, the colored races have made considerable progress toward attaining the white man's death rate. In that advance the medical missionaries and the philanthropic foundations' doctors from the United States have lent an efficient helping hand. Progress toward attaining the white man's birth rate has been appreciable but much less rapid. Consequently, for the next few decades the colored peoples will increase in number more rapidly than the white. But the many complex and often subtle factors in human nature that bear upon reproductivity seem to be essentially the same, regardless of the pigmentation of the skin. In time—three or four decades for some communities, six or eight for others—the balance between fertility and mortality among colored peoples will be similar to that among white people.

It is quite unrealistic to take, for example, the recent percentage growth of the population of India and project it into the future, with the warning that within a century a billion Indians will be jostling one another for food. By the same token, it is altogether fallacious to suggest that continuance of medical missions and further indoctrination of the people of India and China with modern techniques of public health will permit them suddenly to acquire the low death rate of the United States, with a resulting "population explosion" that would have dire consequences. The trend of the recent past is far more likely to continue. Gradually, the death rate will continue to decline and at the same time the birth rate, lagging somewhat behind, will be reduced.

Without going into the technicalities of birth control, or "planned parenthood," as we in Massachusetts prefer to call it, or of the psychological and sociological factors that influence the birth rate in various communities, certain significant correlations may be noted. There is an almost perfect inverse correlation between the birth rate and the per capita consumption of pig iron among the nations. The higher the consumption of pig iron—i.e., the greater the industrialization—the lower is the birth rate. Similarly, there is an almost perfect correlation between literacy and birth rate. The higher the percentage of illiteracy in a nation, the higher the birth rate.

If, then, we are interested in reducing the birth rate among non-Caucasian peoples and thus hastening the stabilization of population in such countries as India, China, Java, and Puerto Rico, the method to be followed is clearly evident: Assist the inhabitants of those countries to accelerate their progress toward mechanization of industry, agriculture, and commerce, and help them in their efforts to reduce illiteracy. The future for such members of the human family is by no means hopeless. Their problems are exceedingly difficult—perhaps even more difficult than our own. But they can be solved. I see no excuse for selling science short.

It is of course true that we have been plundering the earth. But the mistakes of the past are being corrected. We now know how to use without destroying. And it is by no means too late to apply good will, as well as intelligence, to the conservation of nature's stored capital and the expenditure of man's annual income from renewable resources.

It is also true that the road to survival leads to wise adjustment between populations and available resources. Science and technology have charted that road. Mother Earth is rich enough to nourish every man in freedom. Ours is an age of potential abundance, as well as of inescapable interdependence.

Unfortunately, there are people in our country who do not welcome the thought that they should adjust their own lives and the policies of the nation to the requirements of that sort of world. They seem to prefer the strategy of grabbing while the grabbing is good, lest there not be enough to go around. To accept

the fact of interdependence of all the human beings who dwell upon our little planet goes definitely against the grain.

Scientists, by the very nature of their mental habits, are internationalistic rather than chauvinistic in their outlook. They are accustomed to the study of a neutral world of objective facts that are the same, regardless of what nation the observer is a citizen, or to which of the races of men he belongs. They know that there are fellow-scientists in foreign lands who are working on problems more or less akin to those of their own research projects. They recall the beneficial results of free exchange of information and ideas among the scientists of many nationalities in most of the significant scientific discoveries of the past. They are more aware than anyone else of the tremendous indebtedness of American technology to the scientific research prosecuted by citizens of other countries, even since science came of age in America. They know that the progress of science is most rapid when there is the greatest freedom for uninhibited communication among the scientists of the world, such as was provided by the many international scientific organizations, with their world-wide distribution of publications, that were established during the latter part of the nineteenth and the early part of the twentieth centuries. Therefore they want to reduce the keeping of scientific secrets to the absolute minimum necessary for national security in this time of international tension and strife. Therefore, also, they disapprove the red-tape curtain dropped around the United States by the McCarran Act.

Scientists, moreover, are naturally devoted to the principles of democratic freedom that shine so clearly in our constitutional Bill of Rights, based as they are upon the one most important freedom of all, the freedom to think one's own thoughts and to express them so that they may be appraised in the court of public opinion. Any semblance of thought control is resented by the true scientist, because he knows it will blight his intellectual activities or those of another who may be as good a scientist as he. As a matter of fact, in spite of human frailties that occasionally mar its escutcheon, the fraternity of scientists is the outstanding example of a "free society" in modern civilization. Each scientist is not only permitted but encouraged to form and express his own independent judgment. When he thinks others are wrong, he says so. By the same token, he is ready to submit his own opinion to the judgment of his fellows. All are confident that from the clash of opinion and the dust of controversy a collective judgment will be formed that will be generally accepted by all. Lasting friendships may persist, even though differences of opinion have not yet been resolved.

It is not surprising, therefore, that scientists occasionally speak up in defense of a fellow-scientist who is charged with being guilty of disloyalty because of his associations, or who is being persecuted because of allegedly un-American ideas he may have expressed. Even though one scientist may heartily disagree with another's opinions, he knows he must defend the right of the other to express them, else he will be false to his calling as a sincere and earnest seeker of the truth. He trusts the laws of libel and misconduct to take care of any pernicious extension of the principle of freedom and, with Thomas Jefferson, who was a scientist as well as a statesman, he says "We are not afraid to follow truth wherever it may lead, nor tolerate error as long as reason is left free to combat it."

These attitudes, an inevitable consequence of the intellectual discipline of science as a way of acquiring knowledge, are obviously in perfect accord with the genius of American democracy. They are, however, such as to make those who display them especially vulnerable to suspicion and recrimination in times of national fear and hysterical demands for security against dangers, without and within the nation. It is quite unnecessary to mention the many attacks upon scientists in recent years, which serve as straws to show the direction in which some of the antiscientific winds are blowing. If you do not like what a scientist says, "We are not afraid to follow truth wherever it control in America, the wisdom of supporting the United Nations, the sharing of our surplus grain with hungry Indians, or anything else that he may say, the easiest way to stop him is to insinuate that he is dangerously subversive and advocates doctrines that are approved by the Communists or their fellow-travelers.

The machinery for this expression of antiscientific trends is unfortunately extensive and well oiled. Lists of allegedly subversive organizations, membership in which is believed by many to be absolute proof of guilt, have been made public not only by the Attorney General of the United States and the Un-American Activities Committee of the House of Representatives, but also by legislative committees in several states and by numerous private organizations. Black lists of suspected individuals are freely circulated, or sold at profitable prices, by many "patriotic" societies and "protective" associations. There seems to be a well-organized campaign to paralyze all independent thought, discussion, dissent, and protest in America, and men of science are conspicuous among the targets of those who would force their fellow-citizens to think only those thoughts they themselves approve.

Against this trend the scientist should take a firm stand as a champion of intellectual freedom. He must not adopt the defeatist conclusion that the only sure way to avoid penalty for unpopular opinion is to express no opinion at all. Regardless of the odds against him, he must do his best to change the attitudes of mind of those who will yet listen to his words. Education for life in a free society must continue, and scientists have a great responsibility for its success.

Just one specific example of the kind of education I have in mind. Few people know the facts about such lists of subversive organizations as that compiled in the Attorney General's office. Very little publicity has

been given to the ruling of the U. S. Supreme Court a few months ago, which, as former Attorney General Francis Biddle stated in an article in the November 1951 *Bulletin of the Atomic Scientists*, "knocked out the whole system of listing." The court ruled that it was a denial of due process thus to brand organizations without a hearing. We cannot hope to compensate for all the harm already done by the unjustifiable use to which these lists have been put, but we can at least hope to reduce their harm in the future by spreading information about them as widely as possible.

The future is by no means hopeless for science and scientists in America, in spite of the contemporary trends of thought that are antagonistic to them. There is much reason for fearing the adverse elements in the mental climate that surrounds us, but as Robert Oppenheimer has well said, "The answer to fear cannot always lie in dissipating its causes or in yielding to it. Sometimes it lies, simply enough, in courage."

News and Notes

Scientists in the News

Because of his many contributions to the confectionery industry, **James P. Booker** has been chosen as the recipient of the Stroud Jordan Medal for 1952. The award will be made at the fourth annual meeting of the American Association of Candy Technologists on June 3, at the Conrad Hilton Hotel, Chicago.

Harold A. Braendle and **Carl W. Sweitzer**, of Columbian Carbon Company, New York, were invited by the Swedish Institution of Rubber Technology to address its spring meeting May 2–3 on "The Role of Heat in the Carbon Black Reinforcement of Rubber." While in Europe, Braendle and Sweitzer are visiting rubber plants in Denmark, England, France, Germany, Italy, Sweden, and Switzerland.

Melvin Calvin, professor of chemistry at the University of California, Berkeley, has been named 1952 Harrison Howe Lecturer by the Rochester Section of the American Chemical Society. Professor Calvin, who is also director of the Bio-Organic Group of the Radiation Laboratory in Berkeley, was honored for his contributions to theoretical organic chemistry and for his pioneering work on the mechanism of photosynthesis, using isotopic tracers. The Harrison Howe Lecture will be given in Rochester on Nov. 22. This is the eighth award of the honor, which commemorates the services to chemistry of Harrison E. Howe, for more than twenty years before his death in 1942, editor of *Industrial and Engineering Chemistry*.

The Council of The New York Academy of Medicine has announced the appointment of **Robert L. Craig** as secretary to the Committee on Medical Education of the academy. Dr. Craig fills the office heretofore held by **Mahlon Ashford**, who retired. He has practiced obstetrics and gynecology in New York since 1930 and has served continuously on the staff of the New York Lying-In Hospital (New York Hospital), where he is at present associate attending obstetrician and gynecologist. During the same period he has been on the faculty of the Cornell University Medical College, at present as assistant professor of clinical obstetrics and gynecology.

E. C. Drescher has been appointed chief of the Division of Commissioned Officers, Public Health Service, succeeding **Eugene A. Gillis**, who has been assigned as consultant to the Lebanese government to assist in the development of public health services in that country. Dr. Drescher has served as deputy state health officer of Oregon, director of venereal disease control and assistant state epidemiologist of the Kentucky State Health Department, and chief of medical services in Public Health Service District No. 1. Before coming to Washington in 1951 as operations officer of the Division of Commissioned Officers, he was Public Health Service consultant to the city of Pittsburgh.

J. H. DuBois, formerly sales manager of the Plax Corporation, a division of the Emhart Manufacturing Co., has been appointed vice president in charge of engineering of the Mycalex Corporation of America.

The following persons from abroad were recent visitors at the Eastern Regional Research Laboratory of the Agricultural Research Administration, Philadelphia: **B. Eriksson**, Institute for Applied Textile Research, Norrkoping, Sweden; **Gosta Silen**, Finnish Wool Industry Research Laboratory, Helsingfors, Finland; and **K. Sakaguchi**, University of Tokyo.

Luther H. Evans, Librarian of Congress and member of Unesco's Executive Board, was elected chairman of the U. S. National Commission for Unesco. He will serve the remainder of the unexpired term of **George D. Stoddard**, who resigned the chairmanship in order to devote more time to the University of Illinois.

Leonard Greenburg, of the New York State Department of Labor, has been designated the 1952 winner of the Cummings Award, highest honor of the American Industrial Hygiene Association, for his work in the field of industrial health and safety. The association cited Dr. Greenburg, who is director of the New York department's Division of Industrial Hygiene and Safety Standards, for his "contributions to the knowledge and practice of the profession of industrial hygiene." The award is presented annually in

memory of Donald E. Cummings, a pioneer in industrial hygiene, who died in 1942. Working at the Saranac Laboratories in New York State and later at the University of Denver, Mr. Cummings was noted for studies that aided in reducing tuberculosis among miners.

William P. Hieronymus, president of Midland College, Fremont, Neb., has been appointed professor of secondary education at Wagner College, Staten Island, N. Y. He is secretary and past president of the National Luthern Educational Conference. At one time he was president of Hebron Junior College.

Ernest Jawetz, of the University of California School of Medicine, currently on sabbatical leave, is lecturing in England in June. Dr. Jawetz is presenting summaries of research on antibiotic synergism and antagonism at various institutions, and will deliver an Almroth Wright Lecture at St. Mary's Hospital, London, and a MacArthur Lecture at the University of Edinburgh before returning to the U. S.

A grant of $10,000 has been received by the George Washington University School of Medicine from the Lasdon Foundation for laboratory and clinical studies in tuberculosis. Co-investigators will be **Sol Katz,** adjunct clinical professor of medicine, and **Monroe J. Romansky,** associate professor of medicine. Studies will be made on the effects of various drugs, including isonicotinic derivatives, streptomycin, and PAS, on the tubercle bacillus in the laboratory and with patients.

The American-Swiss Foundation has invited **Charles Glen King,** scientific director of The Nutrition Foundation, Inc., and professor of chemistry, Columbia University, to give a series of lectures in Switzerland, June 5–21.

Richard W. Lippman, research associate at the Institute for Medical Research, Cedars of Lebanon Hospital, Los Angeles, has been elected chairman of the Southern California Section, Society for Experimental Biology and Medicine, for the academic year 1952–53.

Otto Maass, director general, Pulp and Paper Research Institute of Canada, and a member of Canada's National Research Council, has been appointed scientific adviser (special weapons) to the Canadian Chiefs of Staff.

Elmer M. Matter, of Grand Rapids, Mich., formerly district manager of the Procter & Gamble Co., has been appointed chief of the glycerine, soaps, and detergents section of the National Production Authority's Chemical Division. Mr. Matter succeeds George A. Wrisley, Sr., of La Grange, Ill., who has resigned to return to his position as vice-president of the Allen B. Wrisley Co., Chicago.

I. A. Merchant, head of the Department of Veterinary Hygiene at Iowa State College, will become dean of the Division of Veterinary Medicine and director of the Veterinary Research Institute on July 1. **H. D. Bergman,** who has served as dean and director since 1943, will relinquish his administrative duties and devote his time to teaching and research.

Reginald James Seymour Pigott has been named recipient of the Egleston Medal for 1952, an award for distinguished engineering achievement. Mr. Pigott is director of the Engineering Division of Gulf Research and Development Company, Pittsburgh, a subsidiary of Gulf Oil Corporation. Since November 30, he has been president of the American Society of Mechanical Engineers. The Egleston Medal, first presented in 1939, is awarded yearly by Columbia's Engineering Alumni Association in honor of Thomas Egleston, who was instrumental in establishing the Columbia School of Mines in 1864.

Peyton Rous, of the Rockefeller Institute for Medical Research; **Francisco Duran-Reynals,** of the Yale University School of Medicine; and **Richard E. Shope,** of the Merck Institute for Therapeutic Research, received the Anna Fuller Memorial Prize, totaling $7000, for outstanding and original research on the role of viruses in cancer. The prize was awarded at the annual meeting of the American Association for Cancer Research. The Anna Fuller Fund was created in memory of his wife by the late Egbert C. Fuller, a businessman of New York and New Haven.

Armando Samper, head of the Scientific Communications Service, has returned to Turrialba from a ten-week study of the status of scientific communications in 11 Caribbean and South American countries. He attended the second session of the Advisory Council of the Scientific Communications Service at the Pan American Union. During his absence **Alejandro MacLean** was in charge.

James Claude Thomson, professor of biochemistry and nutrition and director of nutrition research in the new International Christian University in Tokyo, has recently been granted a leave of absence from Tokyo to serve as medical consultant in the Nutrition Section of the World Health Organization. After short visits in Egypt, Lebanon, and Syria he has gone to Iran where he is cooperating with the Ministry of Health at Tehran, in a survey of the nutritional status of the people in the varied geographical districts of Iran, with a view to organizing a national nutrition program.

Lars Werkö, assistant professor at the Carolinian Institute, Stockholm, who, with **Clarence Crafoord,** will be in charge of the institute's new thorax clinic, will study thoracic surgery buildings and laboratories in the U. S. The latest laboratory techniques in thorax surgery will be studied at a number of hospitals for adaptation at the Swedish clinic, which will be built partly with funds received from the Rockefeller Foundation. Experiences gained at the modern surgical departments of hospitals in New York, Boston, Cleveland, Chicago, Baltimore, and Philadelphia will be the chief objective of Professor Werkö's study.

Education

Under the auspices of the **American Medical Association** a short course in basic electrocardiography will be conducted for AMA members in the Chicago headquarters June 3–6, the week before the AMA annual meeting. Franklin D. Johnston, of the University of Michigan Medical School, will be general chairman; other instructors will be George E. Burch, Louis N. Katz, Gordon B. Myers, and Francis F. Rosenbaum.

Amherst College has appointed 12 new members to its faculty and promoted six others. William W. Stifler, of the Physics Department, will retire at the end of the first 1952–53 semester. Among the new staff members are Arnold Arons and Dudley H. Towne (physics), J. Sargent Russell (economics), and Charles N. Apt (chemistry).

The **University of Connecticut** at Storrs will offer a six-week course beginning June 23, in the theory of the solid state, under the direction of Robert J. Maurer, of the University of Illinois.

Cornell University has taken over the Vicos Hacienda in northern Peru as a social science laboratory in which Allan R. Holmberg, Cornell anthropologist, will direct a project to study the effects of new health measures, agricultural methods, education, and industrialization on the Indian inhabitants. Dr. Holmberg will be assisted by seven graduate students, two of whom are Peruvians.

Eighty men and five women from 35 countries have been chosen to participate in MIT's fifth annual **Foreign Student Summer Project,** starting June 1. The project, which is designed to give outstanding young engineers and scientists from abroad an opportunity to work in MIT laboratories, is financed by private foundations, business corporations, and individuals. An MIT student committee pays the living expenses of the visitors, and the various foreign countries provide the ocean transportation.

Harvard Observatory will hold special informal seminars on Tuesdays and Thursdays for seven weeks beginning July 8. Bart J. Bok will lecture on "The Structure of the Milky Way System," assisted by several Harvard graduate students. The Agassiz Station (formerly Oak Ridge) will be open and will have room for a limited number of guest observers. Qualified visitors will also be welcome at the seminars in Cambridge.

The **University of Rochester,** in a move to combine its men's and women's colleges on the River Campus of the Men's College, will erect new residence and social units and other necessary buildings at an estimated cost of more than $6,000,000. Until the new facilities are available the Women's College will continue to function on the Prince Street Campus. Eventually the Eastman School of Music may utilize one or two of the Prince Street buildings.

Grants and Fellowships

A Frank M. Folsom Scholarship, for students majoring in pure science or engineering, has been established at the University of Notre Dame by the Radio Corporation of America, in honor of the president of RCA. First recipient will be announced next fall.

The **Charles F. Kettering Foundation** has made a grant of $4000 to the University of Chicago to aid in the publication by the Press (in 1952) of a monograph on "The Algae of Illinois," by L. H. Tiffany and M. E. Britton, of Northwestern University.

The **James F. Lincoln Arc Welding Foundation** will award 15 prizes for highway bridge designs entered in its Welded Bridges for Steel Conservation Program. Entries must have been executed within the contest period, Nov. 1, 1951–July 15. The Jury of Award, of which John G. Clark, professor of civil engineering at the University of Illinois, is chairman, will award prizes of $7000, $3500, and $2000, and 12 honorable mentions of $300 each. Dr. Clark is also chairman of the 15-member rules committee. For full information address the foundation, P. O. Box 2035, Cleveland 17, Ohio.

The **National Research Council of Canada** has announced that 10 two-year fellowships tenable at Canadian universities will be available for persons under 35, with the proper qualifications. Stipends will amount to $3000 annually for single, and $3500 for married, fellows, with a grant for apparatus up to $2000 the first year and up to $1000 the second, to be administered by the university.

In the Laboratories

The **Aluminum Company of America** has appointed the following to three newly created vice presidencies: C. F. Nagel, Jr., chief metallurgist, Gordon W. Cameron, and Arthur P. Hall.

American Cyanamid Company, Calco Chemical Division, has appointed R. P. Parker director of chemical research to succeed H. Z. Lecher, who retired on Apr. 1. J. J. Denton will succeed him as assistant director of chemical research.

Armour Research Foundation has named William A. Casler, assistant director of research, manager of program development. Sidney Katz, supervisor of physical chemistry for the Institute of Gas Technology, has been appointed research physical chemist.

Parke, Davis & Co. has established a new branch at Santurce, a section of San Juan, Puerto Rico, to serve Puerto Rico, the Dominican Republic, Haiti, and the Virgin Islands. This brings to nine the number of Parke, Davis overseas branches and plants.

The **John Wood Company** has formed an Engineering and Research Division at its Conshohocken, Pa., plant. Percy S. Lyon, formerly of the Cochrane Corporation and the C. H. Wheeler Manufacturing Com-

pany, is in charge of the department; R. E. Bruckner is director of the mechanical engineering activities, and Harold F. Stone of the chemical engineering activities.

Meetings and Elections

The **American College of Cardiology** will hold its first annual convention in the Hotel Statler, New York, June 6–7. Four scientific sessions will be held in a symposium on "Treatment of the Cardiac." Further information may be obtained from Philip Reichert, secretary, 480 Park Ave., New York 22.

Owen J. Roberts has been elected president of the **American Philosophical Society,** succeeding Edwin G. Conklin, professor emeritus of biology at Princeton, who has been president since 1948. Among new members elected to the organization was Sir Charles Darwin, the English physicist who is a grandson of Charles R. Darwin.

Chi Epsilon, national civil engineering honorary fraternity, will hold its twelfth conclave on the campus of Illinois Institute of Technology Sept. 12–13, just preceding the festivities of the Centennial of Engineering and the Convocation of Engineers. The meeting will mark the thirtieth anniversary of the founding of the fraternity.

A **Conference on Industrial Physics,** arranged by the Institute of Physics, will take place in the Royal Technical College, Glasgow, June 24–28. Subject of the conference will be "Physics in the Transport, Shipbuilding and Engineering Industries." Speakers will include M. G. Bennett, T. A. Eames, N. Fleming, Andrew McCance, D. T. N. Williamson, and Robert Watson-Watt.

The **Federation of American Scientists** has elected Jules Halpern chairman and Victor F. Weisskopf vice chairman. Both will serve on the new Executive Committee together with Lyle B. Borst, retiring chairman, and four others to be selected by the FAS Council. Judith Bregman, Charles D. Coryell, Paul L. Hartman, David Hawkins, David L. Hill, Edwin C. Kemble, M. S. Livingston, Robert L. Platzman, Henry C. Torrey, and Hugh C. Wolfe, were elected council delegates-at-large.

The **New York Academy of Dentistry** installed Henry Hicks, of Greenwich, Conn., as president at its annual meeting in April. Ralph J. Bowman is president-elect, Roland E. Morse vice president, William Ward Tracy secretary, and Gustav P. Frahm treasurer. Dr. Hicks succeeds Lowrie J. Porter.

A **Symposium on Military Medicine** will be held at Murphy Army Hospital, Waltham, Mass., June 23–25. Military doctors will present papers each day, followed by discussion by prominent civilian doctors. Any physician may obtain an invitation and program by writing or telephoning the hospital. Isador S. Ravdin will deliver a dinner address on "Shock" on June 23.

Miscellaneous

A 25-member **Migratory Labor Commission,** appointed by Governor G. Mennen Williams to study the problems of Michigan's seasonal agricultural workers, will operate under the co-chairmanship of Edgar G. Johnston and John F. Thaden. Dr. Johnston is professor of education at Wayne University, and Dr. Thaden is a member of the Department of Sociology at Michigan State College.

On Jan. 10, 1952, a **National Society for Combating Cancer** was inaugurated in Sweden with the support of the Swedish Medical Society and 41 other organizations. The society was formed on the initiative of a group of biological investigators to procure funds for salaries, instruments, experimental animals, and chemicals. Under the patronage of the King, it has as chairman the former chief of the LO, August Lindberg, and as vice chairman and scientific director Hilding Bergstrand, rector of the Caroline Institute for Medical Research. As a result of eight weeks' publicity on the radio program "Radiohjälp," the society received approximately one million kronor ($200,000). Direct appeals via women's and labor organizations are expected to be continued through the year and may produce an additional 400,000 kronor. Funds collected are placed in charge of a board of trustees, who are elected, one from each of the sponsoring labor and social organizations. This large board elects an executive committee and employs a secretary. The research council is headed by Arne Tiselius (biochemist, Uppsala) and temporarily consists of Professors Agren (physiological chemistry, Uppsala), R. Sievert (radiologist, Stockholm), C. Ahlstrom (pathology, Lund), B. Sylvén (pathology, Stockholm), J. Runnström and T. Caspersson (cell research, Stockholm), H. B. Wulff (surgeon, Lund), J. Waldenström (internal medicine, Lund), and M. Strandquist (chief physician, Stockholm). The council is empowered to support all types of research effort, and applications may be made by any competent investigator for any research project of basic significance to the cancer problem. The secretary of the board is Gertrud Julin, Riksföreningen för Kräftsjukdomarnas bekämpande, Karolinska vägen, Stockholm.

Chemicals wanted by the **Registry of Rare Chemicals,** 35 W. 33rd St., Chicago 16, include: calcium palmityl phosphate; methyl aluminum dichloride; ruthenium fluoride; *o*-tert-butyl toluene; 3,5′diiodothyronine; avidin; coprostanone; 2,3-benz-9-anthrone; piperine; 2-ethylhexanedithiol-1,3; quinoline-8-carboxylic acid; 9-anthraldehyde; triethylgermanium hydride; 9,10-dihydrophenanthrene; benzoquinonecarboxylic acid; biliflavin; methyl ammonium chromic sulfate; 3-ethyl-2-aminophenyl benzthiazoline; 1,3,6-trihydroxynaphthalene; coronene; and luciferin.

The **U. S. Naval Postgraduate School,** which was founded in 1909 at Annapolis, Md., has recently been moved to Monterey, Calif.

Technical Papers

Isomorphism of Terramycin and Aureomycin Hydrochlorides[1]

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Previous x-ray diffraction studies on terramycin hydrochloride in this laboratory (*1*) have established the cell size, space-group, and positions of a number of atoms in terramycin hydrochloride. An earlier report by Dunitz and Leonard (*2*) gave the cell and symmetry of aureomycin hydrochloride. The remarkable similarity of these cells suggested that the two compounds might be isomorphous, particularly since on the basis of published analytical data the two antibiotics might differ chemically only in the replacement of a hydroxyl group in terramycin by a chlorine in aureomycin.

If the two compounds did prove to be isomorphous, it is likely that phases of some Fourier coefficients for the electron density maps could be deduced by intensity comparisons. The presence of the additional chlorine in aureomycin would in any case be likely to provide more phase information than would be available from the terramycin measurements.

We have consequently taken single-crystal x-ray patterns of aureomycin hydrochloride and compared these with those previously obtained here for terramycin. The similarity in scattering is striking, and clearly establishes the isomorphism. The crystallographic constants are compared in Table 1.

TABLE 1

CRYSTALLOGRAPHIC COMPARISON OF TERRAMYCIN · HCl AND AUREOMYCIN · HCl

	Terramycin · HCl ($C_{22}H_{24}N_2O_9 \cdot HCl$) [*3*]	Aureomycin · HCl ($C_{22}H_{23}N_2O_8Cl \cdot HCl$)[2]
a	11.19	11.20 ± 0.02
b	12.49	12.89 ± 0.04
c	15.68	15.47 ± 0.02
Space group	$P2_12_12_1$	$P2_12_12_1$
d	1.51	1.5287
Mol wt (chemical)	496.7	515.1*
Mol wt (x-rays)	499 ± 5	514.5†

* Assuming Cl replacing OH of terramycin.
† The molecular weight calculated by Dunitz and Leonard (*2*) does not correspond with the formula they suggest and differs from our own determination.

The molecular weights determined from x-ray and density measurements are compatible with the assumed aureomycin formula.

Three-dimensional x-ray scattering data have been collected for aureomycin · HCl, using CuKα radiation and a Weissenberg camera, just as was done previously for terramycin · HCl. Comparison of Patterson projections for the two compounds, computed on X-RAC, has established the probable coordinates for the chlorine in aureomycin, which apparently replaces the hydroxyl in terramycin. Three-dimensional analyses are in progress. Location of the two chlorines per molecule, and probable location of some 11 lighter (nonhydrogen) atoms in terramycin, by the vector convergence density technique, now render the x-ray study very promising.

The isomorphism of these two compounds is not merely extremely helpful in the x-ray structure analysis, but poses intriguing problems in microorganism metabolism and antibiotic activity.[2]

[1] Development supported by Office of Naval Research, Contract No. N6onr26916, T. O. 16, and by a research grant from Chas. Pfizer & Co., Brooklyn, N. Y.

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[2] A private communication from J. D. Dunitz, received after this note was submitted for publication, reported a parallel observation of this isomorphism.

Physiology of an Infrared Receptor: The Facial Pit of Pit Vipers

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Noble and Schmidt (*1*) in 1937 showed that the sense organ in the facial pit of blindfolded crotalids—rattlesnakes, copperheads, and moccasins—mediates the ability to strike correctly at moving objects such as a dead rat or a cloth-wrapped light bulb and to distinguish between warm and cold ones. They attempted to describe its sensitivity in terms of the reading of a mercury thermometer in the air at the position of the snake's head. However, it seems indicated by their conditions that radiant energy was the effective stimulus. We have undertaken to find out what can be learned of the function of this organ by recording activity from its nerves. The present paper is a preliminary report based on multi-unit analysis.

Specimens of several species of *Crotalus* have been curarized, and the superficial branch of the superior maxillary division of the trigeminal nerve has been exposed, tied, and cut proximally and lifted on electrodes. This is one of three nerves, all from the fifth cranial, ramifying in the thin membrane of the pit organ (*1, 2*). Equally good results have been obtained by a microneedle inserted into the membrane itself.

The nerve proves to be one of those afferents which carry a continuous barrage of impulses in the absence

of apparent stimulation—i.e., is "spontaneously" active. The activity is very complex in that not only nerve impulse spikes, but many slower deflections occur, and the average activity, integrated by a sound-level meter on "slow" setting (time constant = 0.7 sec), still shows fluctuations of 1 or 2 decibels.

Sound, odors, vibration of the substratum, touching the head and pit, and well heat-filtered light of moderate intensity (e.g., a match or flashlight at 5 cm) do not produce any detectable effect on nerve activity. But changes in the level of discharge are produced by mechanical deformation of the membrane, as with a wisp of cotton, by brushing the upper lip with a camel's hair brush (weak effect), by air movement, temperature changes of the body, and by common objects the temperature of which is above or below a neutral point, and which are brought into a receptive field around the face, regardless of intervening air temperature. Air movements must be abrupt, like weak puffs, and close to the face to be effective. Even so, many positions around the face yield no effect, and waving a thermoneutral object near the head is ineffective. Detection of air movement, then, is of doubtful importance in life as a function of this organ, although Noble and Schmidt interpreted some of their experiments on this ground.

Changing the temperature of the body or of the pit without altering the radiant energy impinging on the pit from the environment changes the maintained level of activity in the same direction, but without a high degree of sensitivity. In the extreme case, a change of 0.5° C and usually of 1 or 2 degrees is necessary to cause a detectable change in activity of the whole nerve. (Using a noise-level meter and integrating over several seconds, 1 decibel is about the limit of reliable change.) The organ could then function as an absolute temperature (as distinct from relative temperature) receptor if the brain chooses to use this information. The response—that is, the change in continual nerve activity—is greater at first to a sudden temperature change and then adapts in some seconds to the new level. This adapting fraction could serve as a more sensitive relative temperature receptor. Temperature effects of both types may really be responses to new levels of radiant energy falling on the membrane from the walls of the pit.

Outstanding in sensitivity compared to the above modalities is that to radiant heat. Any warm or any cold object causes a transient response with a threshold that can be roughly indicated by the human hand at 30 cm distance or by a glass of water 1° above or below a glass of water at the neutral temperature, held close to the pit. Since we are dealing with an entire nerve and a fluctuating background activity, it is possible that the threshold is actually much lower than appears from these observations. The neutral point is independent of body temperature and depends on the average radiation from all objects in the receptive field. Cold objects (relative to the field) depress nerve activity even if they are warmer than the body, and they are thus fully as noticeable to the snake as warm objects. Adaptation occurs and is complete except to very warm objects. Upon removal of the stimulus a large change in the opposite direction occurs. Thus an ice cube 5 cm from the pit causes a great inhibition, followed by adaptation, and upon its removal or screening, a large transient increase in nerve activity. The latency of these effects is usually 50–150 msec in the nerve 10 mm from the pit. Strong warm stimuli cause an "on" transient partially adapting to a new, higher level of discharge and an "off" transient in the opposite direction, or sometimes a long afterdischarge instead.

Moving a stimulating object within the receptive field causes noticeable alteration in nerve activity, and this is the only indication of distinction between stimuli, except quantitatively. If we keep the very rich innervation in mind, this suggests that there is localizing ability based on shadows cast on the deeply situated membrane by the margins of the pit. The receptive field (based on experiments with *Crotalus cerastes, C. ruber, C. viridis,* and *C. mitchelli*) is an irregular cone extending in the horizontal plane about 10° across the midline in front and almost at right angles to the body laterally from the pit. In the vertical plane lying obliquely between transverse and long axes and passing through the pit it extends forward only, and from about 35° below to about 45° above the horizontal.

Filter experiments and preliminary infrared monochromator experience indicate that the spectral sensitivity curve will show sensitivity to be extremely low to wavelengths shorter than 1 μ ("near infrared"), high in the region 2–3 μ and probably appreciable, if not high, into the long infrared as far as 10 or 15 μ. This longer end contains most of the energy radiating from objects like the human hand.

Block (*3*) suggested on the basis of its anatomy that this organ works like a Golay pneumatic radiant energy detector—i.e., by absorption of energy on a layer in the chamber behind the transparent membrane such as to result in a rise of temperature, expansion of gas, and consequent deformation of that membrane, the nerve endings detecting the deformation. Such instruments can be both sensitive and rapid. It is highly probable, however, that the pit membrane is opaque to the frequencies received. Moreover, we have experimentally cut the membrane, opening the posterior chamber to outside air, without losing responsiveness. Two other alternatives may be considered. The detection may be (*a*) by specialized molecules activated by the energy absorbed, as in the eye; or (*b*) by nonspecific absorption, resulting in a rise in temperature of the membrane, the nerve endings responding to this.

With respect to (*b*), on the quite improbable assumptions that all the energy received from a 0.1-sec exposure to a Nernst glower is absorbed and heats the 25-μ thick membrane uniformly, and that this has the heat capacity of water, we find that this stimulus at threshold distance in a certain snake would have produced a rise in temperature of the membrane of only

0.014° C; if only the first 7 μ were heated, which would probably include most of the nerve endings (*1, 2*), this figure would become 0.05° C. This is probably not small enough to rule out the possibility of mechanism (*b*), but the rather low sensitivity to temperature mentioned before makes this alternative seem unlikely.

With respect to hypothesis (*a*), there seems little possibility of a mechanism based on the usual photochemical reactions, such as those in the eye, since these are notable for their absence in this low-energy region of the spectrum (which is characterized by changes in vibrational and rotational energy levels as opposed to electronic changes, which are produced by absorption in the visible and ultraviolet). However, absorption bands in the infrared are assigned to specific atom groupings in organic molecules (*4*), so that specific activation of some kind may be possible.

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A Virus Possibly Related to the Psittacosis-Lymphogranuloma-Pneumonitis Group Causing a Pneumonia in Sheep

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A considerable number of sheep suffering from pneumonia are brought to this institution for autopsy. The absence of bacteria of etiological significance in many of the pneumonic lungs which were cultured suggested that in such cases a virus might be the cause, a possibility which has been recognized by others with respect to pneumonia of the ovine species. Accordingly, attempts were made to recover such an agent from these cases.

From 2 of 5 pneumonic sheep lungs an agent was recovered which induced a transmissible pneumonia in albino Swiss mice by intranasal inoculation. Impression smears prepared from the cut surfaces of the consolidated mouse lung, and stained according to Macchiavello's method (*1*), revealed the presence of elementary bodies which were morphologically and tinctorially identical to those of the psittacosis-lymphogranuloma-pneumonitis group (Chlamydozoaceae) of viruses. The agent was again recovered from the second sheep lung, which had been held under dry-ice refrigeration in the meantime, 3 weeks subsequent to the initial isolation. Repeated attempts by serial nasal inoculation in mice failed to recover any transmissible agent from the lungs of either the stock experimental mice or normal sheep.

The mouse-lung-adapted virus was readily propagated in the yolk sac of 5- to 6-day-old embryonating hens' eggs, and was readily transmitted in serial passage. Subsequent to the first several yolk sac transfers, in which only the lower dilutions of inocula regularly proved infective, a 10^{-3} dilution of infected yolk sac regularly killed 100% of the embryos within 4–6 days following inoculation. In yolk sac smears, stained as described above, from moribund and dead embryos, large blue bodies were consistently present; these were assumed to be a developmental stage of the virus. Among them were occasionally observed the small red elementary bodies. A marked pneumonia was induced in mice by the inoculation of infected yolk sac suspension, and typical elementary bodies were regularly demonstrated in lung smears.

An inoculum was prepared from the supernatant obtained by centrifuging a 10% suspension of infected yolk sac at low speed for a short time. A vigorous 9-month-old wether was inoculated with 15 ml of this material, half being given intranasally and the remainder intratracheally. Mice also were inoculated. In addition, 3 kittens from which a transmissible respiratory agent could not be recovered by mouse lung passage of nasal washings, were given a portion of the supernatant by the nasal route. It was considered advisable to include kittens in order to determine whether the agent under study was identical with the feline pneumonitis virus of Baker (*2*) which, it was felt, might reside in the respiratory tract of sheep.

After inoculation the temperature of the sheep rose from a preinjection reading of 38.1° C to 41.2° C and dropped to the former level within 48 hr, where it remained for the next 6 days. Thereafter, until sacrifice of the animal on the 23rd day following inoculation, a fever was recorded which was characterized by intermittent peaks occurring at increasingly frequent intervals, and of progressively greater magnitude. During the 2-day period immediately preceding death the temperature constantly remained between 40.5° C and 41.0° C, and respiratory distress was noted. At autopsy, a pneumonia which, however, was not extensive, was found in the anterior lobes of both lungs, and the agent was readily recovered in mouse lung as described previously. Several of the inoculated mice died of the infection prior to the seventh day following inoculation, at which time the survivors were sacrificed. In all cases an extensive pneumonia had developed, and elementary bodies were readily demonstrated. The kittens, however, remained clinically normal during the 4-week period they were held following inoculation, and lung pathology was absent at autopsy. Attempts to recover the virus from the turbinate bones of these animals by serial passage in mouse lung were unsuccessful.

Urea-treated (*3*) infected and normal crude yolk sacs were used as antigens in complement fixation tests carried out with both homologous and feline pneu-

[1] The author wishes to acknowledge his indebtedness to Joseph K. Saito for extremely able technical assistance; and to D. R. Cordy for helpful suggestions and for providing pathological materials for this study.

TABLE 1

COMPLEMENT-FIXING REACTIONS OF THE SHEEP PNEUMONIA VIRUS WITH HOMOLOGOUS AND FELINE PNEUMONITIS ANTISERA

Serum	Highest dilution of antigen in which complement was fixed in presence of serum		Highest dilution of serum in which complement was fixed in presence of antigen	
	Infected yolk sac	Normal yolk sac	Infected yolk sac	Normal yolk sac
Sheep serum				
Preinfection	1–20	1–10	< 1–4	< 1–4
Postinfection	1–50	1–10	1–32	< 1–4
Feline pneumonitis antiserum				
Kitten "8"	1–40	1–10	N.T.*	N.T.
Kitten 236	1–50	1–10	1–16	< 1–4
Normal kitten serum	1–10	1–10	< 1–4	< 1–4

* N.T. = Not tested.

monitis antisera. Sera of the 3 kittens mentioned above were also tested for complement fixing antibodies to the sheep lung agent. These results were negative and do not appear in Table 1.

In the qualitative test, undiluted through eightfold dilutions of the 10% antigen suspensions were incubated in a water bath for 2 hr at 37° C with a constant (1–8) dilution of each serum specimen and 2 units of complement. After adding a sheep red blood cell suspension which had been sensitized by the addition of 2 units of hemolysin, the tubes were reincubated and the tests read when the control series exhibited the appropriate reaction. Readings were again made after the tests had been held overnight at 4° C. The quantitative test was conducted according to the above procedure, using serial twofold dilutions of each serum specimen and 2 units of antigen. Complete, rather than partial fixation, was selected as the end point. The titers shown in Table 1 refer to the initial dilution of the antigens and the sera, respectively, before the addition of the other reagents.

An elementary body agent has recently been incriminated as the cause of enzootic abortion in ewes in Scotland (*4*). It was demonstrated subsequently that this virus is related antigenically to both the psittacosis and the lymphogranuloma venereum viruses (*5*). The sheep pneumonia virus and the virus of enzootic abortion in ewes are, therefore, undoubtedly related antigenically. However, the agent described in this paper was isolated from individuals in flocks in which there was no evidence of the existence of enzootic virus abortion. Furthermore, the fact that the sheep abortion virus was found incapable of producing pneumonia in either sheep or calves (*4*) is evidence that the two agents isolated from sheep are distinct viral entities.

On the basis of our observations on its host specificity, tropism, and antigenic relationship with the feline pneumonitis virus, it is tentatively concluded that the agent isolated from sheep lung is a new member of the psittacosis-lymphogranuloma-pneumonitis group of viruses.

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Some Aspects of the Phenomenon of Coacervation

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The name coacervation was given by Kruyt (*1*) to the phenomenon of limited solution observed with a large number of colloids and colloid mixtures. A coacervate is thus regarded as a colloidal solution which is immiscible with excess solvent. Bungenberg de Jong (*2*) made an extensive series of investigations along this line and attributed this phenomenon to the separation of extensively solvated colloidal particles out of the solution by the addition of some nonsolvent or precipitant, solvation being due to the electrostatic attraction of the charged colloidal particles. This idea was widely prevalent till 1940, since the recorded data on coacervation were confined mostly to the electrically charged colloidal particles in aqueous solution—e.g., gelatin, gum arabic, starch, etc. In 1942 Dobry (*3*) showed that coacervation can take place in nonaqueous media with high molecular weight substances, which are generally molecular colloids. Thus, in precipitating cellulose acetate and polystyrene out of a good solvent by the addition of a suitable nonsolvent as precipitant, Dobry many times obtained separation of coacervates rather than granular precipitate. We have also observed that in precipitating polymethyl acrylate out of methyl ethyl ketone by the addition of methyl alcohol a viscous liquidlike mass separated out, which on prolonged standing shrank and left a film of polymeric substance at the bottom of the container. Thus it became evident that an explanation based on the electrical charge of the particles should be revised in order to accommodate within its purview cases of uncharged particles as well.

Bungenberg de Jong (*4*) has recently put forward a more general explanation of the phenomenon of coacervation. It is to be noted that until now almost all the substances that can form coacervates are high

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molecular weight chain compounds, be they in aqueous or in nonaqueous solution. Bungenberg de Jong regarded coacervates as macromolecular aggregates in which a considerable amount of solvent is immobilized or occluded inside the loops of molecular skeins. This idea also gets some support from the work of Alfrey, Bartovics, and Mark (*5*) on the solutions of polymers in good and bad solvents. It has been shown by these authors that the molecules of polymeric chain in the dissolved state in good solvents take up an extended structure. As the solvent character is rendered more and more unfavorable by the addition of some precipitant the polymer chain becomes more and more coiled up. So it is expected that at the time of separation the extensively coiled-up polymer molecules will carry along with them considerable quantities of occluded solvents immobilized inside the loops of molecular skeins. The separation of coacervates therefore follows from the idea of flexibility of the chain molecules and the solvent immobilization inside the coiled-up molecules. It follows as a corollary from these viewpoints that if a molecule separates out of the solution in its extended configuration it will give a solid product, whereas if it separates in the coiled-up state coacervation will take place.

In order to test this point experiments were planned taking into consideration the present conception of the change in the molecular configuration of polyelectrolytes under different working conditions (*6*). The best-known example of the coacervation phenomenon is the separation of gelatin from aqueous solution by the addition of alcohol. Gelatin is a protein that contains a number of carboxyl and amino groups distributed along the chain. When sodium hydroxide is added to a gelatin solution some of the COOH— groups are converted into COONa, which in its turn undergoes dissociation into COO^- and Na^+. The protein chain is thereby left negatively charged, and the repulsion between the similarly charged COO^- groups on the same chain will cause the protein molecule to take up an extended configuration. If alcohol is added to the solution, precipitation will take place more or less in the solid form. Similarly, when HCl is added to the solution, the NH_2 groups will be converted into hydrochloride, which will also undergo dissociation, leaving the extended chain positively charged, and the precipitation will lead to solid separation rather than coacervates.

If, however, sufficient sodium chloride is added to solutions of gelatin hydrochloride or sodium gelatinate at different pH's, the dissociation of sodium gelatinate or gelatin hydrochloride will be considerably suppressed, owing to common ion effect; the negative and positive charge centers will be neutralized, and the molecules will take up a less extended, average coiled-up structure. Addition of alcohol to such solutions will lead to coacervation rather than solid separation. The results of precipitation of gelatin from aqueous solution at different pH's by alcohol in the presence and in the absence of sodium chloride are summarized in Table 1.

TABLE 1

PRECIPITATION OF GELATIN BY ALCOHOL

Without NaCl		With NaCl	
pH	Nature of the precipitate	pH	Nature of the precipitate
9.6	Granular solid	9.8	Viscous liquid
8.7	Hard gel	8.5	" "
7.1	Viscous liquid	7.5	" "
5.5	" "	5.7	" "
4.6	" "	4.0	Setting to gel
3.5	Granular solid	3.0	" " "
2.6	" "		

It is evident from Table 1 that in the absence of sodium chloride gelatin separates as granular solid both at higher pH's (where the conversion of gelatin to its sodium salt is nearly complete) and at lower pH's (where gelatin exists as hydrochloride) by the addition of alcohol, whereas in presence of sodium chloride coacervation takes place at all pH's (pH adjustments were done in these cases either by the addition of NaOH or HCl).

In the case of precipitation of gum arabic from aqueous solution with alcohol, similar results have been obtained. At higher pH's separation takes place in the solid form; and in the presence of sodium chloride at those pH's separation of oily droplets (visible under the microscope) takes place. The droplets gradually agglomerate to a sticky, jellylike mass.

These observations, along with the analysis set forth, therefore lend further support to the Bungenberg de Jong explanation of the coacervation phenomenon as due to separation of coiled-up molecules with a considerable amount of immobilized solvent inside the loops of molecular skeins.

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Effect of Heat on the Properties of Urea at its Melting Point

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The melting point of pure urea is 132.7° C as given in the literature (*1*). If urea is heated above its melting point at temperatures from 150° to 200° C, biuret, tricyanurea, and several other products are formed successively. Some of them are generally considered to represent polymerization products of the single

urea molecule. Most of these products are well identified and described in the literature.

Urea was originally considered to be a diamide of carbonic acid. Lately Degering (*2*), as well as Werner (*3*), explained the polymerization tendency of urea as being due to a more reactive form of urea. Several formulas were assigned to this active form. Brauch and Calvin (*4*) explained the presence of an activated form of urea as follows: the C—N distance in the urea molecule was determined to be 1.37 A, whereas in aliphatic amines this distance normally amounts to 1.47 A. The difference in these values may be due to the presence of two modifications of normal urea. Freudenberg (*5*) admits the possible presence of isomorphous forms in urea but the iso-urea could not be detected by x-ray spectrography as practiced at the time of his investigations.

Since this work was carried on at temperatures considerably above the melting point of urea, it was proposed to study the effects on urea when its temperature was varied slightly above and below the melting point.

The following experiments were done with urea, reagent grade. Its melting point was 132.2° C, and its nitrogen content was 45.62%, as determined at the beginning of the tests. Five-g samples, in either open or sealed glass tubes, were submerged in an oil bath which had a constant temperature control. Between each heating cycle, the sample was removed from the oil bath and allowed to solidify in air before it was reheated. After each series of melting cycles the sample was analyzed (Table 1). A Kofler Micro Hot

TABLE 1

UREA REPEATEDLY HEATED AT THE MELTING POINT

Times melted and solidified	Mp(°C)	pH	N_2 content (%)	Solubility in	
				H_2O	Abs alcohol
Urea	132.2	6.8	45.62	.6255	.0871
" 10	124.4–129.5	7.1	45.04	.6543	.0972
" 20	122.4–123.0	9.0	44.22	.6625	.0996
" 30	117.8–118.1	9.1	45.84	.6682	.1000
" 40	112.5–113.4	9.1	46.01	.6740	.0937
" 60	112.7–112.9	7.1	46.15	.6753	.0925

Stage unit was used to obtain temperature readings, which were held constant for 2 hr during the melting process. A lowering of the melting point to approximately 112.5° C will be noted as the most significant change in the urea during this investigation. After 40 melting cycles, however, the melting point became fairly stable.

Samples of urea and iso-urea crystals were powdered to pass through a 300-mesh screen and then worked into thin-walled glass (Keesom) tubes which had a diameter of 0.5 mm or less. The tubes were sealed to prevent absorption of water vapor. A 57.3-mm Debye powder camera with 0.5-mm pinholes was used to obtain the x-ray diffraction patterns. Filtered

FIG. 1. Urea.

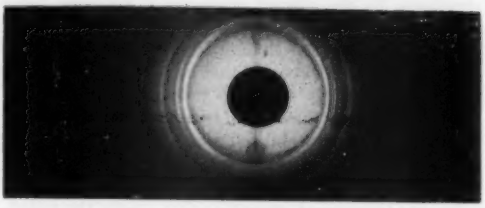

FIG. 2. Iso-urea.

Cu-radiation at 40 kv and 15 ma gave readable lines with 1-hr exposures.

The "*d*" values (spacings of the atomic planes) for the x-ray diffraction lines of the urea were found to be in close agreement with the ASTM values of this substance, but the "*d*" values for the iso-urea x-ray diffraction lines differed somewhat from those for the urea lines. The iso-urea pattern (Figs. 1, 2) shows a diffraction line (third from the center) which is not present in the urea pattern. This line becomes progressively stronger with an increased number of melting operations, and another line farther from the center of the iso-urea pattern becomes progressively weaker with an increased number of melting operations. There are a number of the other lines on the two patterns which do not "match" either in "*d*" values or intensities, so a difference in structure is to be inferred.

Urea is generally considered to be a stable compound. It has been demonstrated experimentally that the stability of urea or its uniformity is questionable and that a new and stable compound is being formed during this treatment as shown by the x-ray diffraction patterns and the more constant melting point. This investigation is a contribution to the theory advanced by Degering and others that it should be possible to prove experimentally that urea consists of isomorphous compounds or may be transformed into isomorphous compounds from its normal state by repeated melting and solidification.

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Sodium Pentobarbital Anesthesia and Mortality from X-Radiation in C_{57} Black Mice[1]

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While studying protective mechanisms against radiotoxicity in mice, it was noted that animals anesthetized during irradiation appeared to have a lower mortality than unanesthetized animals. This observation was further tested and verified, using 157 C_{57} Black mice between 255 and 502 days of age. Sixty-one animals (28 males and 33 females) were anesthetized with sodium pentobarbital, 10–15 min prior to irradiation. The anesthetic dose, administered intraperitoneally, was 0.05 mg/g body weight. The injected solution contained 10 mg sodium pentobarbital/ml. Eighty animals (40 males and 40 females) were given radiation without anesthesia. Sixteen animals (8 males and 8 females) were given 0.005 ml/g body weight of an 0.9% saline solution 10–15 min prior to irradiation. The anesthetized, unanesthetized, and saline-injected animals were approximately balanced as to age representation. Furthermore, we have been unable to demonstrate any significant age variation in response to irradiation in mice of this strain in this age range.

Mice were placed in thin cardboard boxes measuring $2.5 \times 8 \times 10.5$ cm, which were provided with cheesecloth screen air holes. Four animals were placed in each box, and 4 boxes (16 animals) were irradiated each time. The 4 boxes were placed so that they covered a rectangular area 16×21 cm, and this was, in turn, centered on a rice phantom which measured 47×47 cm and was 10 cm deep. This was similar to the radiation-scattering phantoms employed by Ellinger (*1*). The radiation used was produced by a 200 kv machine at 20 ma, with 0.5 mm Cu and 1 mm Al filtration. The target distance was 50 cm, and 36 r/min were delivered for a total air dose of 648 r. In our hands, these conditions of irradiation have repeatedly demonstrated that 648 r represents the $LD_{75/30}$ day dose for untreated mature mice of the C_{57} Black strain.

Only 16 animals could be irradiated at any one time. However, in almost every instance, one half the animals represented anesthetized or saline-injected animals, and the other half represented controls.

The results are shown in Table 1. Only 51% of the anesthetized animals died in the 30 days following irradiation, which is significantly lower than 75% of the unanesthetized animals which died (diff = 4.5 PE).

[1] This work was supported by grants from the American Cancer Society, Maryland Division; The Anna Fuller Fund; and the Bressler Reserve Fund.

[2] We wish to thank Walter Kilby, Department of Radiology, University Hospital, Baltimore, Md., for his cooperation and aid in this project. We also wish to express our appreciation to Ruth Broadbelt and Priscilla Wilson for their technical assistance.

The mechanisms by which sodium pentobarbital reduces radiotoxicity may be due to specific activity of the anesthetic agent or lowering of the metabolic rate and/or hypoxemia during anesthesia. Further work with animals receiving sodium pentobarbital or saline, either 1½ hr prior to or immediately after irradiation, suggests that alteration of a stress mechanism may be responsible for the observed results. Injections of saline, which probably act as "stressors," appear to increase the animals' susceptibility to radiotoxicity, whereas injections of sodium pentobarbital do not have this effect. The anesthetic seems to counteract the stress effect of its injection. Additional experiments of this type are in progress in the hope of obtaining more conclusive data on this point.

TABLE 1

EFFECT OF SODIUM PENTOBARBITAL ANESTHESIA* ON 30-DAY RADIATION MORTALITY IN C_{57} BLACK MICE

Treatment	No. animals	No. dying	Percentage dying
Control	80	60	75
Anesthetized*	61	31	51
Saline-injected*	16	14	87.5

* Anesthetic or saline was injected 10–15 min prior to exposure to radiation.

Studies which have correlated radiotoxicity with metabolic activity during or after irradiation indicate that increased metabolism may lead to increased susceptibility to the damaging effects of radiation and vice versa (*2–5*). Nembutal in anesthetic doses has been shown to lower oxygen consumption (*6*). Anoxia and hypoxemia have also been cited for their protective effects (*3, 4, 7–9*). Thus, reduction of radiotoxicity in anesthetized animals may simply be a reflection of impaired respiration during anesthesia. Actually, hypoxia and lowered metabolic rate may reflect one and the same protective mechanism.

Selye (*10*) mentions the findings of a number of workers which show striking similarities between the changes in animals following x-irradiation and those believed to accompany the "general adaptation syndrome." It has been suggested by Dougherty and White (*11*) that x-radiation has a direct and indirect effect on lymphocytes, the indirect effect being mediated through the pituitary and adrenal cortex. Although barbiturate anesthetics have been shown to act as "stressors" (*10*), barbiturates have also been shown to prevent, under certain circumstances, the discharge of adrenal ascorbic acid following exposure to cold, and the hyperglycemia following various "stressors" (*12*). Thus sodium pentobarbital reduces the radiotoxicity of total body radiation probably through one or more of the proposed mechanisms.

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Polarizing Forces of the Muscarinic Moiety

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As an extension of some recent discussions (*1–6*) concerning the chemical constitutional characteristics of the muscarinic drugs, the following treatment dealing with a quantitative evaluation of the polarizing forces of moiety components has been found to be of particular value. Moreover, since it is a general type procedure which may well find application in other chemical constitution biologic activity problems, a brief communication of the basic approach is illustrated here.

The method of evaluation developed by Price (*7*) was applied in the estimation of the polarizing forces of the moiety components of the well-known muscarinic agents outlined in Table 1. Insofar as possible, the over-all intramolecular distances of the agents compared in each series are nearly constant. It will be seen that decreases in potency in each series are strongly correlated with the absolute difference in polarizing force of the component examined from that corresponding component in acetylcholine.

As is well recognized by other workers in this field, acetylcholine appears to be a "two-headed" moiety, although a quantitative expression of the character of the two heads has been lacking. Somewhat vague references to groups of "high" or "low" polarity and to the degree of methylation of the nitrogen do not

TABLE 1

	Polarizing force of bracketed function in dynes × 10^{-4}	Potency	
		Depressor	Gut stimulation
Series I			
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-\left[-O-\overset{O}{\overset{\|}{C}}-\right]_1-CH_3$	−0.32	1	1
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-[-O-CH_2-]-CH_3$	−1.21	1/3	1/10–1/20
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-[-CH_2-CH_2-]-CH_3$	+0.77	1/6	1/25–1/30
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-\left[-CH_2-\overset{O}{\overset{\|}{C}}-\right]-CH_3$	+0.89	1/70	1/50–1/100
Series II			
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-\left[-O-\overset{O}{\overset{\|}{C}}-\right]-CH_3$	−0.32	1	
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-[-I]$	−0.39	≈ 1	
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-[-Br]$	−0.55	1/10–1/50	
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-[-Cl]$	−0.68	1/20–1/100	
$(CH_3)_3\overset{+}{N}-CH_2-CH_2-[-OH]$	−1.46	1/200–1/1000	
Series III			
$CH_3\overset{O}{\overset{\|}{C}}OCH_2CH_2-\left[-\overset{+}{N}(CH_3)_3\right]$	+3.21	1	
$CH_3\overset{O}{\overset{\|}{C}}OCH_2CH_2-\left[-\overset{+}{N}H(CH_3)_2\right]$	+3.02	1/50	
$CH_3\overset{O}{\overset{\|}{C}}OCH_2CH_2-\left[-\overset{+}{N}H_2(CH_3)\right]$	+2.88	1/500	
$CH_3\overset{O}{\overset{\|}{C}}OCH_2CH_2-\left[-\overset{+}{N}H_3\right]$	+2.64	1/2000	

directly allow for quantitative evaluation in the more exact sense that model measurements do in the evaluation of steric factors. The evaluation of polarizing forces as illustrated above may fulfill to some extent this gap in the theoretical tools of the "structure-activity" pharmacologist.

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Hypothesis of the Biological Action of Radiation

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Numerous investigations on the effect of radiation on living organisms have brought us to a stage where the mechanism of action of radiation on cells may be clarified by mathematical interpretation. The studies of the late D. E. Lea (*1*) initiated such an approach.

Lethal effects of radiation have been studied by a number of authors with a wide variety of experimental materials, partly because of the ease with which experiments can be done in which the criterion of the effect of radiation is the death of the organism or cell, and partly because of the practical importance of the lethal action of radiation on cells in the treatment of cancer.

The manner in which radiation effects the killing of bacteria, or the inactivation of viruses, is becoming clearer. With viruses, the biological effect is believed to be due to a single ionization in the virus; with these materials exponential curves are typical in plots of inactivation vs. dosage. With bacteria, in some cases, such plots give sigmoid curves. Lea attributes sigmoid response curves to the tendency of some bacteria to clump. However, most of the survival curves for cells of higher organisms are also of a sigmoid nature. The formula of Blau and Altenburger (*2*), which is known as the multihit theory, is considered as explaining the facts of the case reasonably well. There are some discrepancies in it, in the experimental results from some studies, which cannot be fitted even by modifications of their formula.

Comparisons have been made between experimental data and the formula arising from the following hypothesis.

Rather than consider that there is only one radiation-sensitive region in a cell, which is the viewpoint of the multihit theory, assume that there are in a cell n molecules essential to the continued existence of the cell. Assume that the cell can survive if no more than r molecules out of the n are damaged by ionization from radiation—that is, the cell dies if more than a certain percentage of the n molecules are damaged, and that each molecule is damaged by one ionization. Then the following considerations arise:

a) Just as in the disintegration of radioactive elements, the probability that a molecule escapes damage is $e^{-\sigma t}$ where σ = action coefficient and t = duration of radiation; accordingly, $1-e^{-\sigma t}$ represents the probability that a molecule is damaged.

b) If we take a large number of cells, each of which contains n molecules, the first term in the expansion of the formula

$$[e^{-\sigma t}+(1-e^{-\sigma t})]^n$$

gives the probability that a cell suffers no damage to any of the n molecules after time t, the second term that one in n is damaged, and the $(r+1)$st term gives the probability that r of the n molecules suffer damage.

If we suppose that the cell can survive if no more than r molecules are damaged, then the survival curve is given by the following formula:

$$y = e^{(-\sigma t)n} + {}_nC_1 e^{(-\sigma t)(n-1)} \cdot (1-e^{-\sigma t}) + \cdots + {}_nC_r e^{(-\sigma t)(n-r)} \cdot (1-e^{-\sigma t})^r$$

$$= \sum_{i=0}^{i=r} {}_nC_i e^{(-\sigma t)(n-i)} \cdot (1-e^{-\sigma t})^i. \qquad (1)$$

For simplicity, we may substitute x for $e^{-\sigma t}$ and we may then write Eq. (1) as follows:

$$y = \sum_{i=0}^{i=r} {}_nC_i x^{n-i}(1-x)^i,$$

$$\frac{dy}{dx} = (n-r)\,{}_nC_r x^{n-r-1}(1-x)^r.$$

The integral of this last expression is

$$y = (n-r)\,{}_nC_r \int_0^x x^{n-r-1}(1-x)^r dx. \qquad (2)$$

The incomplete β-function is defined by

$$\beta_x(p,q) = \int_0^x x^{p-1}(1-x)^{q-1}dx,$$

so the indefinite integral in Eq. (2) can be expressed as

$$\beta_x(n-r, r+1).$$

The complete β-function is

$$\beta(p,q) = \int_0^1 x^{p-1}(1-x)^{q-1}dx = \frac{(p-1)!\,(q-1)!}{(p+q-1)!},$$

so that

$$\beta(n-r, r+1) = \frac{(n-r-1)!\,r!}{n!}.$$

The coefficient in (2) is

$$(n-r)\,{}_nC_r = \frac{n!}{(n-r-1)!\,r!}.$$

Thus the survival curve (2) can be expressed in the form

$$y = \frac{\beta_x(n-r, r+1)}{\beta(n-r, r+1)}, \quad x = e^{-\sigma t}. \qquad (3)$$

The values of this expression can be found in Pearson's Tables of the incomplete β-function. The survival curves obtained from this formula are similar to those of Blau and Altenburger, although it is difficult to decide upon the values of n and of r from the experimental curve. Such an attempt has been made, for example, by determining the ratio of the doses required for 10% kill and for 90% kill.

If we put $n=1$ and $r=0$ in (1) or in (3), the survival curve is an exponential. For $n>1$ and $r=0$, an exponential curve is also obtained. This case is known as multitarget, not multihit. Finally, the case $r=n-1$, $n\geq 2$ corresponds to clumping, and a sigmoid curve is obtained.

If we consider delayed division of the cell rather than lethal action, then r or r/n will vary with the stage of the cell (for example, prophase) and will therefore be a function of the time of irradiation: $r/n=F(t)$. Thus the hypothesis that has been advanced in this paper makes it easy to understand the concept of the cumulative dose as formulated by D. E. Lea.

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Comments and Communications

A Citizen's Duty

Everyone should vote in our national and local elections. The votes of the readers of this journal, who represent a group of the highest intelligence, are especially desirable. Yet those who are responsible for arranging national meetings of scientific, technical, and trade associations apparently have no regard whatever for election day. Last election day the country was flooded with technical meetings ranging from the National Academy of Sciences and American Petroleum Institute to countless trade organizations. In very few states is it possible to vote *in absentia* or by letter. Many technical people, therefore must choose between their duty at the polls and their presence at a society meeting. Why not recognize our obligations as citizens and, throughout the country, arrange all association meetings on dates that will not conflict with voting?

Paul D. Foote

Gulf Research and Development Company
Pittsburgh, Pennsylvania

Flash in Photomicrography[1]

A major problem in photomicrography is the elimination of vibration in the apparatus or in the building housing the apparatus. This problem becomes acute whenever long exposures or high magnifications are required. Photomicrography in this laboratory has been relatively difficult because the framework structure contains vacuum pumps and compressors, which may be in operation throughout the working day. Although several methods were used to eliminate vibration in the photomicrographic equipment, none was completely successful. The introduction of flash lighting eliminated the effects of vibration and yielded excellent photomicrographs (*1*).

A microscope lamp (Spencer #735A) with a 100-w coil filament, bayonet base projection bulb was aligned and adjusted to provide "Köhler illumination" (*2*). After the desired field had been selected and brought into critical focus, the projection bulb was replaced by either a Westinghouse speed midget (SM) or G-E #5 flash bulb. The SM flash bulb was ideal for photomicrography because of its speed and safety. It should be noted that the flash bulb must be fired with a d-c voltage of not more than 6 v. Illumination may be controlled by neutral density filters, crossed polaroid disks, or a ground-glass filter. Should the illumination prove insufficient, as could be the case with oil immersion objectives and long bellows extension, a faster film may be used.

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[1] This work was supported by a contract between the University of California and the Office of Naval Research.

[2] The opinions and assertions contained in this report are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or naval service at large (Art. 1252, *U. S. Navy Regulations* [1948]).

Reservist Reaction

The comments by Charles G. Wilber, entitled "Mobilization of the Reserve," which appeared in Science, December 7, 1951, merit reply. . . . No mature reservist expects to avoid performance of duty very long merely on the basis of personal preference. Similarly, the scientist-reservist does not expect blanket deferment, hoping merely that when he is called to duty the position to be occupied will permit him to perform optimally in a professional capacity. Surely, and rightly so, the medical profession would

complain bitterly if a physician were ordered to any duty other than a medical assignment. It is this type of misassignment that has irritated the reservist.

To turn to the less lofty comments made by Mr. Wilber, the gravy apparently soaked up by members of the Reserve is very thin. Reserve status training may, in the very long run, permit promotion, but changes in grade are so slow that no officer expects to advance very far merely on the basis of inactive duty training. Of more concern to the reservist is the income loss generally accompanying recall to active duty. Complaint on this score would not be limited to reservists if other civilians were similarly demoted financially. Concerning payment for inactive duty training, most scientists are, or are being, organized into research and development units and thus do not draw training pay. Scientists in combat units—where they do not belong—may draw training pay, depending upon the type of unit. Should these men not accept this money as long as they feel they are misassigned?

Mr. Wilber labels as "pure fiction" the claim that a shortage of technically trained personnel exists, and insists that our military leaders should not pay undue heed to the demands made by some scientists. Fortunately, the highest military echelons include civilian advisers for precisely such problems, and numerous scientific societies are extending their services along these lines.

R. C. BARD

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THE Reserve was formed to train men for active duty in case of general mobilization. As yet we have not come to this point. I have given my time to the Reserve to train men so that I would be doing my part both by being a scientist in industry and a member of the Armed Forces Reserve. True, we have collected pay for this, but we did give our time for the pay and owe the government nothing on that point. If teachers were hired to do this work, it would cost a great deal more than we are paid. It must be kept in mind that we are not at war and there is no general mobilization, in which case I would want to be the first to be called.

There are many men, trained and given a college education by the government, who have not served any active duty and are now free, and who could be called for a tour of duty, leaving the trained and experienced scientists to develop better means for the total defeat of Communism.

S. J. TASSINARI

Nesconset, Long Island, New York

CHARLES WILBER challenges a complaining reservist to prove his point *scientifically*, but he himself refrains from any such scientific method to support his subsequent assertion that the supply of technical men is adequate. So it was, before World War II. However, because of the decidedly scientific aspect of current wars, a shortage of technical men was experienced from 1943 to 1946. To fill the gap, the government recruited for training as technicians and "junior scientists" many thousands of male and female clerks and recent high school graduates, paying handsomely in salaries, in facilities, and in precious time. The government, however, failed to relieve from their military duties the vast numbers of personnel who were already in uniform, and who had paid, out of their own pockets and by virtue of their own desires, for a technical education. One detachment of draftees arrived at Edgewood Arsenal in the fall of 1940, over 200 strong, of which only a few did not possess a degree. These were mostly chemists, engineers, and the like. Several had Ph.D.s.

As to the statement that governmental scientific projects are adequately staffed, I should want to add that, if by adequate, Wilber means plentiful, he is correct. Nevertheless, the system being as it is, free competition based on initiative and merit is lacking in all but a few government technical installations.

The contents of the communication entitled "Scientific Manpower," which appeared in the July 27 (1951) issue of SCIENCE, should be given consideration by all. The outline therein presented recommends itself to any honest-thinking person, whether scientist or not.

Reservists may be classified in two very broad groups: those who are in the government service as civilian technical personnel, and those who are not. My guess is that the ratio of reservists recalled to active duty from the first group to the number of reservists recalled to active duty from the second group would be very significant, could it be known. Perhaps it would be *scientific* if the AAAS, the ACS, and other similar organizations conducted a survey along such lines. It would certainly be in the national interests if concrete reforms were brought about to insure us against the repetition of the worst of national wastes—that of a trained man.

ANTHONY O. MIRARCHI

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DR. WILBER'S letter in SCIENCE rings bells with me. Please accept my congratulations on this letter, which is as *hard common sense* as I have seen in a long time.

S. W. GEISER

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I DO not agree with Tassinari's comment that there is no general mobilization. If one were to talk to boys of high school and junior college age, it would be rather apparent that there is a widespread mobilization, including general drafting of young men. I agree with him that the many men who were educated by the government should be required to put in service. . . .

Concerning the letter by R. C. Bard, the original communication from the reservist to which I made an answer merely restated the old threadbare gripes of World War II concerning the misuse of scientific

personnel. I reassert that many members of the Reserve were glad to accept inactive duty pay as long as they could stay safely at home. Many of these same individuals did everything under the sun to get out of the Reserve and to obtain extensive delays in reporting for active duty during processing. I agree with Bard that recall to active duty does result in appreciable financial loss. I certainly agree that every effort should be made to place reservists who are scientifically trained in appropriate military positions. The individual reservists are, in many instances at fault for being misplaced. Many reserve scientists wanted to stay in combat units in order to collect inactive duty pay. At the same time, they could have been transferred to research and development units had they so requested. These latter units, however, had their inactive duty training without pay.

It should be pointed out to Anthony O. Mirarchi that most government laboratories seemed to have a rather adequate supply of scientific help. One would anticipate that a critical shortage of scientists would show itself in the service laboratories. By this I do not mean that we have a tremendous oversupply of scientists, but in any time of national mobilization, we do not have an oversupply of punch-press operators, iron, steel, and other resources.

The final paragraph in Mirarchi's letter suggests that a careful study or survey should be made, possibly by the AAAS or the American Chemical Society, to ascertain just what the facts are. On the basis of these facts, it would then be possible to avoid serious wastage and misassignment of trained men. With this latter point of view, there can be no argument, but until we have valid facts available for study, I still feel that the original criticism published in SCIENCE is unwarranted, and I base these conclusions on a rather good knowledge of the Reserve program as it involves the reserve scientist.

CHARLES G. WILBER

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A Simple Pipetting Device

THERE is a need in any laboratory working with radioisotopes for a simple, safe, versatile, and inexpensive device that will permit accurate delivery of solutions from a pipette. For the pipetting of solutions of soft β-emitters a device used in this laboratory meets these requirements, but it does not appear to be used elsewhere.

It consists of a three-way glass stopcock with an outlet through the bottom of the stopper. (Stopcock 7460 Catalog LP28 of the Corning Glass works. The smaller size is preferred.) The side arms are cut off, leaving convenient lengths. To one side arm a short length of thick-walled gum-rubber tubing is fitted for attachment to the pipette. To the outlet through the stopper a rubber bulb of convenient capacity is attached. It is expedient to provide a spring-clip or an elastic band to keep the stopper well-seated.

In use, a pipette is attached as indicated above. The stopper is turned so as to connect the rubber bulb with the pipette, and liquid is drawn up into the pipette. The tip of the index finger is applied to the end of the free side arm, and the stopper is turned to connect the two side arms of the stopcock. Delivery of the liquid is now controlled with the tip of the finger in the usual manner. The device may be used in the hand, or it may be held in a clamp that can be raised or lowered.

In the event that some liquid is inadvertently sucked into the rubber bulb, no harm is done to the operator or the apparatus. The latter may be easily decontaminated.

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Dalhousie University

Distilled Water from Boiler Steam

ALTHOUGH distilled water is steam condensate, condensed boiler steam cannot ordinarily be considered distilled water, because boiler steam is usually a mixture of liquid and, frequently, solid base dispersed in small proportions in the vapor phase.

The availability of the "Liqui-jector," a device for trapping entrained liquid in compressed air lines, led me to investigate the possibility of stripping entrained boiler water and solid matter from process steam to improve the quality of the resulting condensate. A unit was very kindly supplied me by George W. Jordan, Jr., of the Selas Corp. of America, Philadelphia. This was connected to a steam line, and the steam passed through it. Condensing this steam provided water with a reading varying between 0.1 and 0.3 ppm on a Solu-Bridge conductivity meter. The water was pyrogen-free, showed a negligible residue on evaporation, and otherwise met the requirements of water for injection, USP. The steam line involved was from a vertical boiler operating on full load, in which the evaporating surface was very small for the quantity of water evaporated; and the steam carried much entrained feed water.

A full-scale condensing unit was assembled and has been in continuous operation since May 1950, providing Courtland Laboratories of Los Angeles with water for biological and pharmaceutical products, directly from boiler steam. Very little attention is required; care must be taken to prevent flooding the Liqui-jector with line condensate, and the water-repellent element in the Liqui-jector must be replaced from time to time.

E. T. MARGOLIS

E. S. Miller Laboratories, Inc.
Los Angeles, California

Book Reviews

A Dictionary of Antibiosis. Compiled by Leonard Karel and Elizabeth Spencer Roach. New York: Columbia Univ. Press, 1951. 373 pp. $8.50.

The word antibiotic has, during the past decade, been employed with connotations ranging from its literal meaning through all shades of modification to the highly restricted meaning frequently used. The authors have chosen to use a liberal, rather than the literal, interpretation of the term and define an antibiotic as "a substance derivable from living organisms and capable of adversely modifying the vital functions of specific microorganisms."

A Dictionary of Antibiosis consists of an alphabetical list of members of both the plant and animal kingdoms, macroscopic and microscopic, that have been tested for antibiotic activity, the named antibiotic substances they produce, and the microorganisms used in the demonstration of the reported antibiotic activity. Under each entry is a short statement concerning, in the case of an antibiotic, its source, isolation, empirical or proposed structural formula where known, antibacterial activity, and toxicity; in the case of a plant, animal, or microorganism tested for antibiotic activity, the substance produced or a statement that no activity was demonstrated. Statements are keyed to bibliographic references at the end of each entry; these in turn are keyed by year (and letter where necessary) to the alphabetically arranged bibliography occupying the last 55 pages of the volume.

One gets the impression from using this dictionary that the authors have been lax in consulting and noting the earlier literature of antibiosis, and at times they are inconsistent in their listings. The antibiotic asiaticoside is listed with the unsatisfactory: "see *Centella asiatica.*" Under this entry one finds that *Centella asiatica* is a higher plant, derivatives of which are used in the treatment of leprosy, from which asiaticoside, centelloside, asiatic acid, centoic acid, and centellic acid have been isolated. The fact that asiaticoside is a glucoside consisting of two D-glucose and two L-rhamnose moieties bound to a triterpine acid, asiatic acid, is not mentioned, nor is the reported antitubercular activity, both *in vitro* and *in vivo,* of a water-soluble derivative, although this was published in a readily available journal. The entry opposite this, however, gives the empirical formula, fusing point of the crystals, method of extraction, and "spectrum" of a plant antibiotic of apparently no therapeutic value. Lupulon and humulon were reported as antibiotics 11 years prior to the earliest reference noted by the authors. Horseradish was shown prior to 1941 to contain a volatile antibiotic, allyl isothiocyanate, active against the colon bacillus and the human tubercle bacillus; the antifungal activity of the isothiocyanates had been shown three years previously. The reference under horseradish, however, is to a 1944 paper showing "extracts of which are ineffective *in vitro* against *Staphylococcus aureus, Escherichia coli, Phytomonas campestris* and *Ph. phascoli.*"

The task of the lexicographer is ever exacting, and the value of his labors is measured by the degree of exactness attained. Several dictionaries (or handbooks, if you will) of antibiotics have appeared, each succeeding one more ambitious than its predecessor and, in general, more valuable. The present dictionary is by far the most ambitious, and it is to be regretted that the success in dealing with the "words of antibiosis" is not commensurate with the scope of the work. It is, nevertheless, the best book on the subject yet to appear.

JOHN HAYS BAILEY
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Genetics in the 20th Century. L. C. Dunn, Ed., for The Genetics Society of America. New York: Macmillan, 1951. 634 pp. $5.00.

Celebration of the first half century of genetic research, and the publication of this volume as evidence thereof, serve a triple purpose in addition to paying homage to Gregor Mendel. First, the entire volume reminds us that great and significant facts can remain long unrecognized, as Mendel's did for 35 years, before their sudden impact jolts us into new ways of thought and action; it contains a profound lesson in humility and tolerance at a time when these virtues are judged vestiges of a bygone era. Second, each paper in the volume, by pointing with unconscious pride at achievements already made, serves to justify and to reaffirm our faith in the principle of truth established by verification at a time when the principle, particularly as it applies to genetics, is under ideological attack. And, third, each paper is also evidence that, despite the great advances made, and the far-reaching influence genetics has had on biological and philosophical thought, our knowledge of heredity is still fragmentary.

In the 26 papers presented, the reader will gain the impression that genetics has already become a central core of thought, penetrating, illuminating, and enriching many other fields of human endeavor and interest. Nevertheless, as a discipline, genetics has no vested interests it seeks to preserve, no dogma it wishes to perpetuate. Its very dynamism precludes such attitudes. To the continued credit of Mendel, it might be pointed out that one of the few seemingly certain facts of genetics that has withstood repeated scrutiny is Mendelian segregation, and, as subsequently shown by other workers, its physical relationship to the chromosomes. The fundamental unit of heredity—singly as the gene and collectively as the chromosome—is still very much an unsolved problem in its physical and chemical structure and its mode of action in development. Its role in evolution has only recently been put

to experimental test. The present status of genetics can be summed up by saying that the gene has been clearly apprehended, but certainly not fully comprehended.

As befits the occasion, *Genetics in the 20th Century* is opened by Goldschmidt's essay on the relation of genetics to science in general. It is a panorama which he saw unfold and grow and to which he contributed in no small measure. This introduction is followed by three papers that survey the early days of Mendelism and the period that preceded it. Muller then brings himself and his fellow-scientists up to date in a closely argued paper on the development of the gene theory, a procedure that Ephrussi and Sonneborn follow with the theories of extranuclear inheritance, particularly as they relate to microorganisms. The short but solid paper by Sturtevant will bear rereading often—if only as a reminder that some of the widely accepted ideas on crossing over and other genetic processes are still unsettled questions in need of further exploration. This stands in sharp contrast to the stimulating but more free-wheeling hypothesizing of Darlington at the cytogenetical, Mather at the biometrical, and Mirsky at the cytochemical levels. Dobzhansky and White, in characteristic fashion, cover their respective fields of evolutionary study, and the role of genetics in applied breeding and in human studies occupies a series of eight papers. As representative of developments at the chemical frontiers of genetics—cytochemistry, immunogenetics, and biochemical genetics—Mirsky, Caspersson and Schultz, Irwin, and Beadle discuss the remarkable advances of the past 15 years. Lederberg ably presents the progress made in the new field of bacterial genetics, for the development of which he is in large measure personally responsible. Julian Huxley's essay on "Genetics, Evolution, and Human Destiny," erudite and thought-provoking in content and range, ends the book.

As a group, these papers make up a commendable volume, and the reader will be amply rewarded for the time spent in its perusal. It is, in addition, a fitting memorial to Mendel, and a credit to its editor and to the Genetics Society of America, which sponsored the symposium at which the papers were presented. The wide variety of subject matter and approach is in itself a testimony to the spreading influence, both theoretical and practical, of genetics in many other fields, and the diversity of ideas, freely expressed and as freely criticized, is further evidence of free inquiry intelligently pursued. Yet one wishes that other topics had been included in the volume. Nothing would have been more appropriate than to have had summarized the fundamental contributions of the maize geneticists. Mangelsdorf's essay on hybrid corn touches only a part of a much larger subject; those who heard Stadler speak at the symposium will regret that his talk has been omitted; McClintock's recent studies of gene variability, if discussed, would have indicated new vistas for future study. Conspicuous by their absence, also, are the studies of the entire group of Carnegie geneticists and cytogeneticists, as well as of the plant evolutionists from the West Coast. One must be reasonable, however, for it is obvious that a symposium has its limitations in time, and a volume in space, and the omissions in no way detract from the general excellence of the book as a survey of the current status of genetics here and abroad.

C. P. SWANSON

Department of Biology
The Johns Hopkins University

Scientific Book Register

Biological Antioxidants. Transactions of the Fifth Conference, November 30–December 1, 1950, New York. Cosmo G. Mackenzie, Ed. New York: Josiah Macy, Jr. Fdn., 1951. 187 pp.; cumulative index. $3.75.

Important Tree Pests of the Northeast. 2nd ed. Henry I. Baldwin *et al.*, Eds. Concord, N. H.: Evans Ptg., 1952. 191 pp. $2.00.

When Doctors Are Patients. Max Pinner and Benjamin F. Miller, Eds. New York: Norton, 1952. 364 pp. $3.95.

The Theory of Electromagnetic Waves. A symposium held at New York University, June 6–8, 1950. New York–London: Interscience, 1951. 393 pp. $6.50.

Die Relativitätstheorie: Die Spezielle Relativitätstheorie, Vol. I. 5th ed. M. v. Laue. Braunschweig, Germany: Friedr. Vieweg, 1952. 198 pp.

Isotopes in Biochemistry. Proceedings of the symposium held in London under the auspices of the Ciba Foundation. G. E. W. Wolstenholme, Ed. Philadelphia: Blakiston, 1951. 288 pp. $5.00.

Dialogues Concerning Two New Sciences. Repr. Galileo Galilei; trans. from Italian and Latin by Henry Crew and Alfonso de Salvio. New York: Dover, 1952. 300 pp. $1.50 paper.

Nomography and Empirical Equations. Lee H. Johnson. New York: Wiley; London: Chapman & Hall, 1952. 150 pp. $3.75.

Trauma, Growth, and Personality. Phyllis Greenacre. New York: Norton, 1952. 328 pp. $4.50.

Bacterial Physiology. C. H. Werkman and P. W. Wilson, Eds. New York: Academic Press, 1951. 707 pp. $8.50.

Motor Phonetics: A Study of Speech Movements in Action. 2nd ed. R. H. Stetson. (Published for Oberlin College by North-Holland Pub. Co., 1951.) Order from Psychology Dept., Oberlin College, Oberlin, Ohio. 212 pp. $3.50.

Manipulations de Chimie. 2nd ed. Clément Duval. Paris: Masson, 1951. 382 pp. 2500 fr.

Thomas Jefferson: Scientist. Edwin T. Martin. New York: Schuman, 1952. 289 pp. $4.00.

Cultural Sciences: Their Origin and Development. Florian Znaniecki. Urbana: Univ. Illinois Press, 1952. 438 pp. $6.00.

Collected Papers of the Macaulay Institute for Soil Research, 1948–1951, Vol. III. D. N. McArthur, Ed. Aberdeen, Scot.: Macaulay Institute, 1951. 52 papers.

Liver Injury. Transactions of the Tenth Conference, May 21–22, 1951, New York. F. W. Hoffbauer, Ed. New York: Josiah Macy, Jr. Fdn., 1951. 320 pp. $3.75.

Liver Disease. Ciba Foundation Symposium. Sheila Sherlock and G. E. W. Wolstenholme, Eds. Philadelphia: Blakiston, 1951. 249 pp. $5.00.

Introduction to Mycology. J. A. Macdonald. New York: Academic Press; London: Butterworths, 1951. 177 pp.

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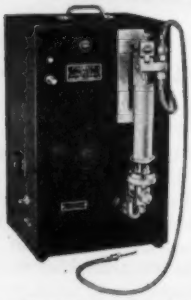

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Publications Received

Bertrand Russell's Dictionary of Mind, Matter and Morals. Lester E. Denonn, Ed. New York: Philosophical Library, 1952. 290 pp. $5.00.

Body, Mind and Sugar. E. M. Abrahamson and A. W. Pezet. New York: Holt, 1951. 206 pp. $2.95.

Brief Trigonometry. Rev. ed. Edward A. Cameron. New York: Holt, 1952. 152 pp. $2.10.

The Clinical Use of Fluid and Electrolyte. John H. Bland. Philadelphia–London: Saunders, 1952. 259 pp. $6.50.

Cybernetics: Circular Casual and Feedback Mechanisms in Biological and Social Systems. Transactions of the Eighth Conference, March 15–16, 1951, New York. Heinz von Foerster, Ed.; Margaret Mead and Hans Lukas Teuber, Asst. Eds. New York: Josiah Macy, Jr. Foundation, 1952. 240 pp. $4.00.

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Literature of the Polychaetous Annelids: Bibliography, Vol. I. Olga Hartman. Los Angeles: The author, Allan Hancock Foundation, Univ. Southern California, 1951. 290 pp. $4.50.

Man on his Nature. The Gifford Lectures, Edinburgh, 1937–38. 2nd ed. Sir Charles Sherrington. New York: Cambridge Univ. Press, 1951. 300 pp. $6.00.

The Phase Rule and its Applications. 9th ed. Alexander Findlay; rev. by A. N. Campbell and N. O. Smith. New York: Dover, 1951. 494 pp. $1.90 paper; $5.00 cloth.

Play, Dreams and Imitation in Childhood. Jean Piaget. English trans. of ***La formation du symbole chez l'enfant*** by C. Gattegno and F. M. Hodgson. New York: Norton, 1952. 296 pp. $5.00.

Poultry Breeding Applied. 2nd ed. F. A. Hays and G. T. Klein. Mount Morris, Ill.: Watt Pub., 1952. 250 pp. $3.50.

Prism and Lens Making: A Textbook for Optical Glassworkers. 2nd ed. F. Twyman. London: Hilger & Watts, 1952. (U. S. distrib.: Jarrell-Ash, Boston.) 629 pp. $11.25.

Psychoanalysis and Group Behavior: A Study of Freudian Group Psychology. Saul Scheidlinger. New York: Norton, 1952. 245 pp. $3.75.

Religious Beliefs of American Scientists. Edward LeRoy Long, Jr. Philadelphia: Westminster Press, 1952. 168 pp. $3.00.

The Rh Blood Groups and their Clinical Effects. Medical Research Council Memorandum No. 27. P. L. Mollison, A. E. Mourant, and R. R. Race. London: Medical Research Council, H. M. Stationery Off., 1952. vi + 72 pp. 3s.

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The Table Rock Basin in Barry County, Missouri. Lee M. Adams. Columbia: Missouri Archaeological Soc., 1951. 64 pp. Illus. $1.00.

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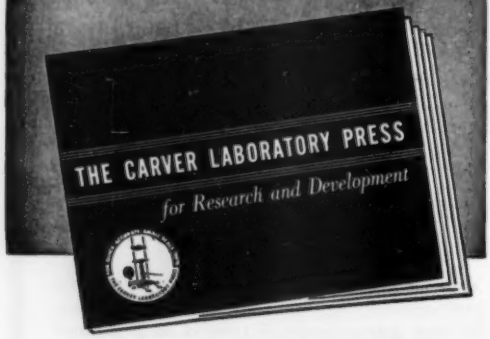

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May 29–31. American Academy of Dental Medicine. Mount Royal Hotel, Montreal.

May 29–June 9. International Convention on Large Electric High Tension Systems. Paris.

June 1–4. American Leather Chemists Association (Annual). New Ocean House, Swampscott, Mass.

June 1–4. American Society of Refrigerating Engineers. Atlanta.

June 1–6. Society of Automotive Engineers (Summer). Ambassador and Ritz-Carleton Hotels, Atlantic City.

June 2–6. Conference on Fibre Blends (Annual). Edinburgh.

June 3. Chemical Institute of Canada (Annual). Montreal.

June 3–7. Société de Chimie Physique and Thermodynamics Commission, International Union of Physics. Conference on Phase Changes. Paris.

June 4–10. International Mechanical Engineering Congress. Stockholm.

June 5–7. Canadian Society of Microbiologists. University of Montreal.

June 5–7. National Society of Professional Engineers (Annual). Tulsa, Okla.

June 5–8. American College of Chest Physicians (Annual). Congress Hotel, Chicago.

June 6–7. American College of Cardiology (Annual). Hotel Statler, New York.

June 6–7. American Rheumatism Association (Annual). Hotel Conrad Hilton, Chicago.

June 7–8. Society for Investigative Dermatology (Annual). Hotel Sherman, Chicago.

June 8–12. Canadian Gas Association. Chateau Frontenac, Quebec.

June 8–12. Institute of Food Technologists (Annual). Grand Rapids, Mich.

June 9–10. Chemical Specialties Manufacturers Association (Midyear). Hotel Statler, Detroit.

June 9–12. Air Pollution and Smoke Prevention Association of America. Hotel Statler, Cleveland.

June 9–13. American Medical Association (Annual). Chicago.

June 9–13. International Symposium on the Reactivity of Solids. Gothenburg, Sweden.

June 9–13. National Fire Protection Association (Annual). Hotel Statler, New York.

June 9–13. Symposium on Molecular Structure and Spectroscopy. Department of Physics and Astronomy, Ohio State University, Columbus.

June 9–21. International Organization for Standardization (Triennial). Columbia University, New York.

June 11–13. American Congress on Surveying and Mapping. Washington, D. C.

June 11–13. Symposium on Electron Transfer and Isotopic Reaction. Division of Physical and Inorganic Chemistry, American Chemical Society, and Division of Chemical Physics, American Physical Society. University of Notre Dame, Notre Dame, Ind.

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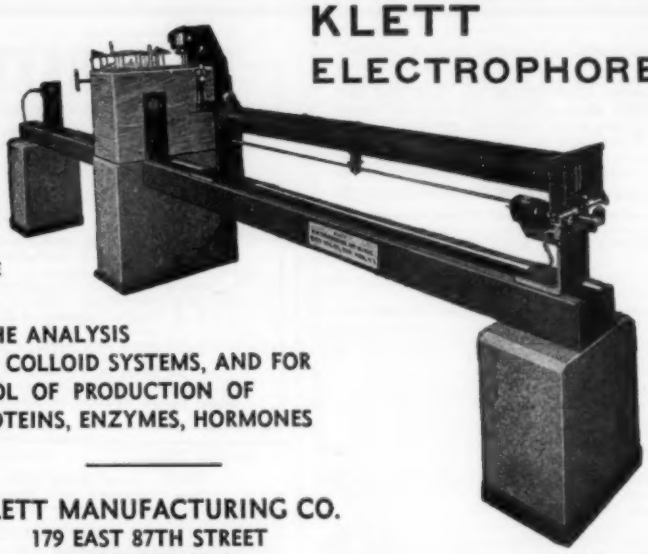

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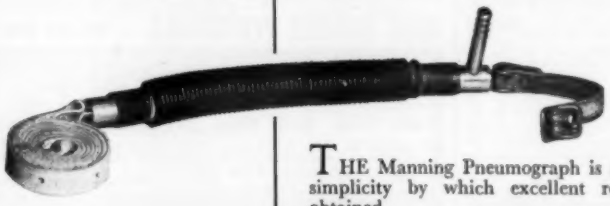

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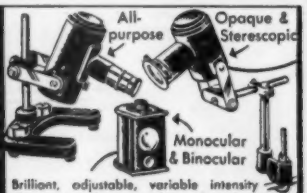

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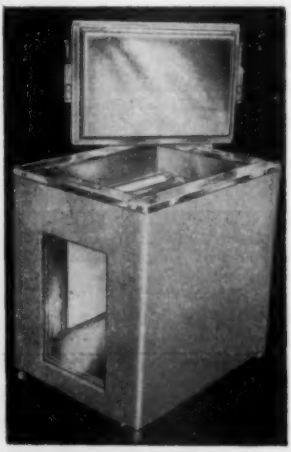

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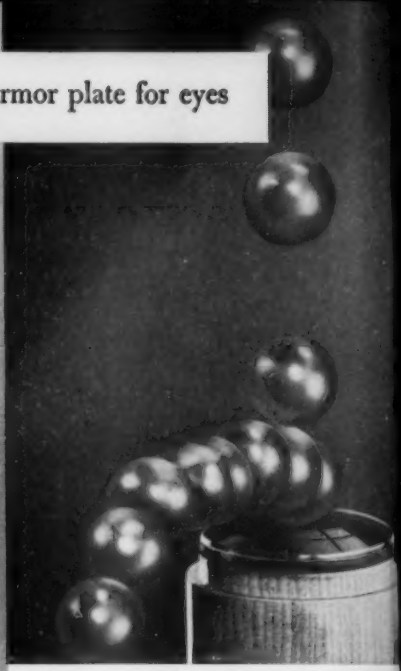

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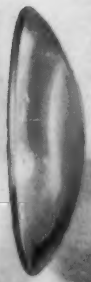

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